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EDITORIALS

A NEW DEPARTMENT

DURING the past nine years, ever since we have edited The American Journal of Surgery, we have received, read and answered hundreds of letters from subscribers and readers of the Journal. Many of these letters were from physicians located in various parts of our country, Canada, Mexico, Porto Rico, Cuba and South American countries, describing the symptoms, and physical and laboratory findings of a case, and either asking us to make a diagnosis or appealing to us to outline suitable treatment. It has been our custom to send these inquiries to those whom we thought especially fitted and equipped to answer the questions asked.

Feeling there are many of our subscribers who at times wish information regarding the many aspects of a surgical problem, or who wish to be informed regarding certain drugs, procedures, technique, tests and the literature on and about a topic—surgery in its widest sense—we plan to inaugurate a department in the Journal to handle such matters. Beginning with the July or August number we will publish several of these letters and the answers sent the writers, and this department will be continued each month.

This service *must be limited to our subscribers*, who are urged to enclose a self-addressed, stamped envelope with each letter. They will be answered in the quickest possible time. A subscriber may write as often as he wishes and ask as many questions as he desires.

We feel that this service will prove of inestimable value to our subscribers, and we sincerely hope they will take immediate advantage of it.

T. S. W.

MATERNAL MORTALITY AND OBSTETRIC CONSCIENCE*

THE maternal death rate is a cause of grave concern. It is clear however, that modern limitation of the size of families with growing legions of abortions, relative increase in the number of primiparae with their higher incidence of difficult deliveries, and the growing age of primiparity itself, seriously affect comparison with older figures. Death certificates too, have been subjected to closer scrutiny, the New York survey alone indicating a total error of nearly 18 per cent. It is probable that improvement in the death rate, though not apparent, is none the less real.

Failure of statistics to yield to medical papers and discussion, revision of the undergraduate curriculum, certification of specialists, increased numbers of hospital beds, governmental investigations and popular education and movements is a mystery to some of us. Yet obviously all these have not been enough if statistics are accepted at their face value.

So long as obstetrics is an art, it will never be possible to teach more than obstetrical catechism in the medical schools; there is neither opportunity nor time enough to teach that which must be learned by practice, not precept. The young graduate is far better trained than his predecessors, yet we are still waiting for tangible results.

Statistical analyses are but a means to an end, and international comparisons are particularly futile. We are apt to lose sight of that. Of themselves statistics accomplish nothing, merely pointing out the avoidable coefficients of maternal mortality. It is a fact that all studies show that approximately one-half of the maternal deaths are preventable, yet even these findings are not conclusive. Though based on accurate information, interpretation of human clinical data is not easy. The specialist's conscience, or the statistician's, highly developed and rigidly consistent, though aware of important social and economic trends may not give them true values when assigning deaths to preventable columns.

Education of the public is valuable and necessary, but time consuming and difficult. Told that complications are preventable, women expect none. They should be told that most of their hazards can be forseen and controlled, but that pregnancy and labor are by no means safe undertakings. That is quite different. The time worn concept that childbirth is a physiological process should be summarily discarded as a harmful platitude. DeLee has insisted upon this for years. There will always be mortality, and it cannot be prevented by "protesting to your physician, to your mayor, to your governor, to your congressman, to your president." This interesting advice to the mothers of America appeared last March in a magazine with wide circulation among women in this country. The press can do us great service, but overemphasis on preventability will only hurt the good cause.

A very large proportion of maternal deaths is inevitable. It is not a simple problem; in fact it is a very complex and difficult one. Antepartum hemorrhage can not be prevented, nor will good management ensure safe delivery. Eclampsia may occur in spite of excellent supervision. Sepsis, the yardstick of intrapartum care, may follow spontaneous delivery, and does occur with increased incidence in operative deliveries where no other method of treatment was possible. The diagnosis of disproportion is not easy, and its management by induction, trial labor, difficult forceps or cesarean section involves alternative but

* Read before the Brooklyn Gynecological Society, May 1, 1936.

no less considerable factors of risk. The less common presentations of the fetus and, more than anything else, posterior positions of the occiput increase maternal as well as fetal mortality.

No doubt the death rate is high. Certainly we are not satisfied. In the final analysis however, we are not concerned with percentages of preventability, or the recriminations which they invoke. If the mortality is unnecessarily high, and we believe it is, it can be reduced. Social and economic factors are involved, for surely the deaths from intentional abortion are beyond our control. Statisticians assign the mortality of criminal abortion to homicide; deaths from self-induced abortion are assigned to puerperal causes, but these too are largely criminal and not self-induced, though they may appear to be. Reduction of mortality is a social as well as a medical problem.

Prenatal care must be adequate, not perfunctory. In toxemia and hemorrhage its function is plain and well understood. Not so clear however are its implications in the all important matter of safe delivery, yet if it does not accomplish that, it is worth nothing.

We must remember that anesthesia, in itself a blessing, in a great many cases slows labor and increases the incidence of forceps deliveries. Interference, whether indicated or not, is the commonest cause of puerperal infection. Skill and judgment so necessary for any operative delivery other than low forceps, are no less requisite when we allow women to remain long in labor. Placenta previa and ablation of the placenta are formidable complications which tax the skill of the most expert, and eclampsia is no different. The outstanding feature of the Children's Bureau survey was that one-quarter of all the maternal deaths followed abortion; they were mostly due to sepsis, accounting for nearly half of all the deaths from puerperal septicemia, the greatest single cause of maternal mortality. That is important. When we are told that 19 per cent of the deaths in New York City, 24 per cent in Boston, were due to cesarean section, we must listen. Cesarean is not for the novice or the casual obstetrician.

The hospital has very definite obligations in this matter of maternal welfare. Large or small it must closely supervise the obstetrics practiced within its walls, for responsibility for the patient does not rest entirely with the doctor. Not all hospitals are safe places for expectant mothers, and the small institution may be excellent, or it may be sadly inadequate, hardly deserving the name of hospital at all. Every hospital should be safe. This is not only what women rightfully expect, but the best interests of the institution, patient and doctor are served no other way. Facilities must be mobilized for advice and help, consultation must be easily obtained when indicated. Nothing must be left undone. The patient must be protected, the physician supported whether he wishes it or not. Then he will grow in knowledge and experience as he multiplies his contacts with the form and substance of good obstetrics. This is the best kind of postgraduate education.

Established moral values have broken down. Conscience asks if this is right, and the inner voice is always so clear that it is impossible to mistake it. Whether it is an intuitive or acquired facility of moral perception, conscience covers everything within a man that has to do with the decision and direction of his moral conduct. Every one of us worthy of our high tradition carries with him an accusing or a comforting witness. He only is content whose conscience is clear.

The obstetric conscience is acquired, and skill and judgment with it. It may be defined as a sense of obligation to obstetric principles. It never swerves from the basic principle of preservation of normal function. It never interferes unnecessarily, unwisely or without counting the cost. It stands firm against the importunity of sympathetic but unknowing relatives. It is proof against hurry and convenience.

It constantly weighs two lives in the balance of experience and knowledge. It crosses no frontiers without a responsible guide. It never forgets its plain duty. God help her who is so unfortunate as to place her trust in one who scoffs at conscience and God help him, too!

The experienced general practitioner, with an obstetric conscience, is the best practitioner of obstetrics. We need more obstetric physicians, less surgeons. We need hospitals keenly conscious of their responsibility to the public.

Nearly a hundred years ago (1842) Oliver Wendell Holmes, reading his "Essay on the Contagiousness of Puerperal Fever" before the Boston Society for Medical Improvement, spoke to the medical profession of the world:

The woman about to become a mother or with a newborn infant upon her bosom, should be the object of trembling care and sympathy wherever she bears her tender burden, or stretches her aching limbs. The very outcast of the streets has pity upon her sister in degradation, when the seal of promised maternity is impressed upon her. The remorseless vengeance of the law brought down upon its victims by a machinery as sure as destiny, is arrested in its fall at a word which reveals her transient claim for mercy. The solemn prayer of the liturgy singles out her sorrows from the multiplied trials of life, to plead for her in her hour of peril. God forbid that any member of the profession to which she trusts her life, doubly precious at that eventful period, should hazard it negligently, unadvisedly or selfishly.

Time changes. Conscience remains.

Charles A. Gordon.

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TOTAL THYROIDECTOMY IN ANGINA PECTORIS AND CONGESTIVE FAILURE*

THREE YEAR POSTOPERATIVE REVIEW OF 16 PATIENTS

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TODAY we are entering upon an era of surgical attacks on numerous diseases which have hitherto been treated along purely medical lines. These are chiefly incurable chronic ailments with a progressive tendency to fatality, or acute medical infections in which, despite medical treatment the mortality remains seriously high.

The surgical treatment of all of these diseases has had to go through stages of experimentation before finding justification and general acceptance. In some, the role of surgery is now on a firm foundation. In gastric and duodenal ulcer, apart from acute surgical complications, surgery, in selected cases, has its definite place; in tuberculosis, surgical procedures have completely revolutionized the treatment of that disease in the last few years.

In other diseases the value of surgery is still unproved, in the experimental stage and not generally accepted. In the acute group may be mentioned the treatment of acute lobar pneumonia by artificial pneumothorax, which is carried on in the hopes of reducing the high average mortality in this illness.

In the chronic group we may mention the operations of sympathectomy and of stripping the adrenal capsule in malignant hypertension and the total removal of the thyroid gland for the treatment of intractable cases of angina pectoris and congestive heart failure.

In view of the apparently favorable results reported by Blumgart, and by Cutler and their associates, we were led to hope that some of the symptoms might be alleviated in patients who had resisted medical treatment; and consequently three years ago we performed a thyroidectomy in a selected series of cases of congestive heart failure and angina pectoris. While only 16 patients have been under observation two years or more since operation, we are presenting our results for comparison with those already reported, in the hope of aiding in the determination of whether the surgical procedure is justified as a therapeutic measure in these two diseases.

RATIONALE OF OPERATION

A brief historical sketch may be the most satisfactory means of approach to an understanding of the basic philosophy underlying the selection of total thyroidectomy as the surgical procedure considered suitable in these cases.

As early as 1825 Parry commented on the close relationship between congestive heart failure and thyrotoxicosis. He noticed the frequency of the onset of congestive failure or angina pectoris, either coincident with or following the appearance of exophthalmic goitre, and he also observed a subsidence of the signs of congestive heart failure following a decrease in the enlargement of the thyroid gland.

* From the First Medical and Surgical (Columbia University) Divisions, Bellevue Hospital. Presented in part before the Section of Medicine, New York Academy of Medicine, March, 1936.

In 1902 Kocher's son reporting his father's cases, clearly demonstrated the improvement in congestive heart failure following subtotal removal of hyperactive thyroid gland. These observations have been repeatedly confirmed by other clinicians. Although at present there is some difference of opinion as to the etiological influence of thyrotoxicosis per se in the production of congestive heart failure, it is well known that when thyrotoxicosis occurs coincidentally with congestive failure there is a very marked clinical improvement in the cardiac status following subtotal thyroidectomy.

As regards angina pectoris, Francois Franck, as early as 1899 put forward the suggestion that the cervical sympathetic chain might contain afferent fibres from the heart, and also suggested that the pain of angina pectoris might be relieved by surgical interference with this system. However, it was not until 1916 that Jonnesco performed the first operation, removing the three cervical and the first dorsal sympathetic ganglia on both sides. In his first case the result was excellent, but the technical difficulties involved, militated against the wide employment of this operation. Later follow-up studies in a series of 66 cases showed that only 53 per cent have enjoyed a satisfactory result. Coffey and Brown of San Francisco in 1923 claimed good results merely by the removal of the superior cervical ganglia, or the division of its main branch. But later in a larger series of cases this showed only 48.5 per cent of satisfactory results. Other methods suggested and carried out for the relief of pain in this condition have included removal of the thoracic ganglia by a posterior approach, with paravertebral alcohol or novocaine injections of the rami communicantes and cutting of the depressor branch of the vagus.

An explanation of these variable and unsatisfactory results probably lies in the newer conception of the cardiac innervation as stated by Heinbecker:

> Pain fibres from the human heart and the first portion of the aorta are found in all sympathetic nerve trunks supplying efferent fibres to these structures. These fibres enter the central nervous system via the fifth cranial nerve, via the rami communicantes, and by the dorsal roots of the 8th cervical and upper 6th and 7th thoracic nerves . . . The complete removal of the cervical sympathetic chain or the alcohol injection of the nerve roots from the 8th cervical to the 7th thoracic levels will not in themselves eliminate all pain pathways.

In 1927 Blumgart observed that the velocity of the blood flow was directly determined by the metabolic rate, the higher the rate, the greater the velocity. He also observed that in individuals with congestive heart failure, although the metabolic rate was normal, there was a compensatory lowering of the blood velocity which increased when these patients began to exhibit clinical improvement.

With these facts known, it was felt that circulatory deficiency depended somewhat on a deficiency of the blood supply for the metabolic needs, and that congestive heart failure occurred only when the metabolic needs were not adequately met. Therefore, it seemed reasonable that if metabolic demands could be lowered to a level that could be supplied by the damaged heart, then the signs and symptoms of failure should disappear.

Consequently, Blumgart, Levine and Berlin of Boston began to treat patients with congestive failure by complete extirpation of the normal thyroid gland. Subtotal thyroidectomy was performed on the first 2 cases with a marked tempory improvement, but when the remaining gland tissues began to regenerate and the metabolic rate rose, there was a recurrence of the original symptoms of failure. As a result of these experiences they then decided in 1932 to perform total thyroidectomies to see if a state of myxedema, which could be regulated by thyroid extract, would permit maintenance of the improvement over a longer period of time. Total ablation of the gland was

deemed essential as any vestige of thyroid tissue would regenerate and vitiate the benefit of the operation.

They also felt that total thyroidectomy might be of benefit in angina pectoris, as they believed that the considerations already stated regarding congestive failure, might be equally applicable to angina pectoris. To quote from them,

> The higher the metabolic rate the greater are the output of the heart and the velocity of the blood flow. The consequent increased work of the heart necessitates an increased coronary blood supply. Because of these considerations and because the intrinsic needs of the myocardium rise along with those of the rest of the body, the blood supply to the heart must be greater at normal metabolic rates than at the lower rate of myxedema. With arteriosclerotic narrowing of the coronary vessels the blood supply to the heart through these vessels may be inadequate to the needs of a normal metabolic rate, although sufficient for the needs of the heart at a lower metabolic rate.

The foregoing theories as to the effect of total thyroidectomy were the basis of the original work in this new field of therapy. It was the favorable results reported by Blumgart, Levine and their associates which led us to do this work at Bellevue Hospital, where there are an exceedingly large number of cardiac patients with the usual proportion of those with congestive heart failure who are never long compensated, except when hospitalized.

Since the original work of Blumgart and his associates, several unexpected findings have arisen which are not adequately explained by the original theories. Illustrative of this is that immediately following the operation both groups of patients experience marked relief. The anginal patients are often free from pain and the congestive failure patients are relieved of palpitation and heart consciousness, and not infrequently, a rapid disappearance of liver enlargement occurs. These effects have been obtained in the majority of cases, but the basal metabolic rate has not fallen significantly for at least three weeks and not usually below minus 20 per cent for three or four weeks following the operation. This has necessitated bringing in some new factors to account for the rapid immediate improvement. Several have been suggested, but none of them wholly adequate.

There is some evidence that clinical improvement in cardiac decompensation is not entirely dependent upon volume output of the heart. In other words, improvement in back pressure is not definitely related to any change in the cardiac output.

There is also some clinical and experimental evidence which tends to show that there is a fundamental difference in the response of the heart to injected or secreted adrenalin after total thyroidectomy. Minimal amounts of adrenalin injected subcutaneously before the operation produced anginal pain; double or triple these amounts postoperatively failed to produce pain. It is known that myxedema lowers the sensitivity to adrenalin, but there are almost normal quantities of the thyroid principle in the circulation for at least a week postoperatively. Therefore, unless one considers the action of some unknown hormone (as Cutler suggested at one time) the explanation of this early lowered response to adrenalin is not clear.

There is a further suggestion that the adrenals and their secretion are implicated by the studies in skin temperature of the extremities. In a series of 13 patients reported by Cutler and Schnitker, they found there was a definite increase in vasodilatation, comparable to that achieved by various operations on the sympathetic apparatus.

Blumgart and his co-workers believe that the immediate postoperative relief of anginal pain is due to the interference of the sympathetic nerve supply during the operation itself, as the thyroid is richly supplied with sympathetic nerve fibres and that this particular early beneficial effect is only temporary. However, the proportion of patients with early relief of pain following total thyroidectomy with

its relatively small interferences with the sympathetic nervous system, is large, if not larger, than the percentage of relief obtained with the much wider interference with the operation of cervicothoracic sympathectomy.

Horgan and Lyon reported favorable results of angina pectoris and congestive failure in a few patients in whom they limited their operation to ligating and cutting the superior and inferior thyroid arteries on both sides. The series reported was obviously too small to draw final conclusions, but it was of interest.

At the present time, though 2 cases with severe anginal pain had this operation done in our clinic with no relief of pain, it is impossible to arrive at an all-inclusive explanation of the benefit obtained by total thyroidectomy, but it would appear that at least three factors are of importance: (1) the lowering of the basal metabolic rate, (2) the interference with the sympathetic nervous system and (3) the change in the response to adrenalin.

Our study is based upon the postoperative review of 16 cardiac patients subjected to total thyroidectomy, 6 of whom suffered from severe angina pectoris, presumably due to coronary sclerosis, and 10 from cardiac decompensation, secondary to rheumatic, arteriosclerotic or syphilitic heart disease.

The series is comparatively small, from a statistical point of view, and the maximum period of observation only three years, with the most recent cases in the series operated upon two years ago. Nevertheless our results added to those of others have led us to believe that in carefully selected cardiac patients who do not respond to all available medical measures, the removal of the entire thyroid gland may prove to be a valuable therapeutic procedure.

None of the patients in our series showed any clinical signs or symptoms of hyperthyroidism and the operative basal metabolic rates were within normal limits in all except one. In this instance the preoperative basal metabolic rate was plus 46 per cent and plus 25 per cent. The patient however, showed no clinical evidence of thyrotoxicosis and the excised thyroid gland, as well as those of all the other patients in the series, proved to be grossly and microscopically normal. In one patient, the preoperative basal metabolic rate was minus 14 per cent.

Our follow-up study was directed with several objects in view: (1) the attempt to evaluate the procedure as a therapeutic measure in severe intractable heart disease; (2) to afford the patients such medical therapy for their cardiac condition as might be necessary following the operation, since the operation per se has no apparent effect upon the underlying pathological process in the heart itself and (3) to endeavor to recognize, observe and treat any sequels or complications that might ensue from the operation itself. The patients were observed at frequent intervals following their discharge from the hospital to the cardiac clinic. Our follow-up included complete histories, physical examinations, frequent teleroentgenograms and electrocardiograms. At frequent intervals, estimations of the circulation time by the sodium cyanide method, and venous pressure determination by the direct venipuncture method were made. Our study also included basal metabolism rates and blood chemistry determinations at frequent intervals, the latter including calcium, cholesterol and non-protein nitrogen.

SELECTION OF PATIENTS

A large number of cardiac patients from the wards and cardiac clinic of the First Medical Division at Bellevue Hospital were studied with this therapeutic procedure in mind, but only a relatively small group selected. In an attempt to obtain a satisfactory clinical appraisal of this procedure, we felt at the outset that it was essential to select only those patients in whom it might be possible for us to analyze critically the results following operation.

In the anginal group, only those patients were selected in whom the attacks of severe precordial pain occurred quite regularly after a definite amount of exertion; all of our patients had in addition heart pain on rest (decubitus angina) and the seizures were so painful that they interfered with such ordinary activities as walking one city block or less and necessitated frequent doses of nitroglycerine or amyl nitrate. Those patients were excluded in whom the attacks occurred at irregular intervals, or in whom the serial electrocardiographic examination demonstrated progressive coronary artery disease. Four patients with angina pectoris had suffered from one or more attacks of coronary closure and showed electrocardiographic evidence of myocardial degeneration associated with coronary sclerosis. We avoided advising operation upon patients who suffered from a recent attack of coronary thrombosis, i.e., a closure that occurred within four to six months prior to operation. The duration of the anginal attacks averaged about two years with the exception of one patient who suffered for eight years. We also excluded a large group of introspective anginal patients in whom there were superimposed confusing nervous or neurotic symptoms because of the difficulty we might encounter in evaluating results in this type of patient, since the estimation of any postoperative improvement in the anginal group is entirely subjective.

In the group of patients suffering from cardiac decompensation, greater difficulties were encountered in establishing satisfactory criteria for the proper selections of patients for operation. Because of the marked variability in the clinical course of patients suffering from cardiac decompensation, we felt at the outset that only those patients with congestive failure should be selected for operation who had been observed and treated for a long period prior to operation. Most of the patients in this group had had repeated admissions and had been observed for a period ranging from nine months to six years. A careful clinical study of the frequency and severity of the episodes of cardiac decompensation prior to operation was compared with a review of similar bouts of congestive failure following operation.

In the group with congestive heart failure, during the earlier period of the work, the operation was performed during a period of advanced decompensation. Later, the operation was advised only when the signs and symptoms of congestive failure had improved or disappeared with rest in bed, digitalis, diuretics and other measures directed toward the treatment of congestive heart failure.

It is necessary to note, however, that two of our most striking results in this group occurred in patients who were operated during a period of advanced congestive failure.

It seemed very likely as observed by others that the most satisfactory patients in the congestive failure group would be those who exhibited a slowly progressive clinical course or in whom the status was relatively stationary. We have felt it was best to limit this therapeutic procedure to that group of patients which gave a history of repeated periods of decompensation upon discharge from the hospital, but who would regain compensation when hospitalized and under treatment; showing they still had some reserve cardiac power. In other words, patients who give histories of rapidly progressive heart disease are considered unsuitable for total thyroidectomy. This is well exemplified by one of the patients operated upon early in this study (Case IV).

In the group with valvular disease one of our chief difficulties has been to exclude those patients with active pathological processes in the heart. Because of the very close casual relationship between active rheumatic infection in the heart and cardiac decompensation it was felt it was essential to eliminate those patients who exhibited clinical or laboratory evidence of active rheumatic process, such as

low grade fever or persistently elevated sedimentation rate. It is quite obvious that if such patients were selected any improvement that might occur after total thyroidectomy might well be attributed to the abatement of active rheumatic infection in the heart rather than the result of the operation itself. We therefore attempted to select those patients with recurring circulatory failure with no evidence of any active inflammatory process and in whom we felt the lesions were stationary, yet who in spite of all known medical measures were somewhat alleviated but nevertheless remained chronically incapacitated.

We have in general excluded patients suffering from syphilitic heart disease (aortitis, aneurysm, aortic insufficiency), because of the well established tendency in such patients, once congestive failure has occurred, to run a progressively down hill course. We have had but one experience in this series with a patient suffering from syphilitis aortic insufficiency; the improvement thus far in this particular patient has not been striking.

OPERATIVE PROCEDURE

At the suggestion of one of us (C. W.), all of our patients have been operated upon under cervical block anesthesia. General anesthesia has been avoided and the immediate postoperative course has been remarkably uneventful. A cervical block anesthetic following Labat's technique has been used most satisfactorily in all of our cases. Approximately 100 c.c. of 1 per cent novocain solution with five drops of adrenalin are used. Five cubic centimeters of this solution are injected over the transverse process of the second, third and fourth cervical vertebras on both sides and approximately 15 c.c. are injected subcutaneously and subfascially just behind the sternomastoid in its midportion. This gives complete anesthesia which usually lasts for at least two hours. A search is always made for any aberrant thyroid tissue. Following the suggestion of Berlin, the vocal cords are examined by the direct method after the first lobe of the thyroid has been removed without disturbing the operative field. This is done to make certain that there is one intact cord before proceeding with the operation.

In spite of the emotional strain of the operation only one of our patients suffered a severe anginal attack during the operation itself. Most of the patients, as is usual following any thyroid operation suffered from a mild tracheitis and difficulty in swallowing for about two or three days. No postoperative pulmonary complications developed in any of our patients. In 2 patients, symptoms of tetany, evidenced by numbness and tingling in the extremities, and positive Chvostek signs appeared during the first week following the operation. These symptoms were readily controlled by the administration of viosterol and large doses of calcium lactate. None showed any severe signs of tetany such as carpopedal spasm or convulsions and the mild symptoms noted did not recur after treatment and did not require continued calcium therapy.

We encountered only one instance of recurrent laryngeal paralysis, probably due to a collection of serum, and the symptoms were quite alarming; there were marked stridor, aphonia and respiratory embarrassment. Fortunately this proved to be transient and eighteen months following the operation there was no evidence of vocal cord paralysis.

We were interested in the problem of surgical myxedema and its sequels; we endeavored to learn if such a drastic procedure as complete removal of so important a structure as the normal thyroid gland might provoke such marked symptoms and signs of thyroid deficiency, that the clinical picture of myxedema might prove to be more serious and more distressing than angina or congestive failure. Would these patients develop profound structural and functional dis-

turbances such as myxedema heart, severe anemia and other changes that have been generally attributed, directly or indirectly to decrease or loss of thyroid activity? The duration of the elapsed postoperative interval, namely three years, is obviously too short to reach any final conclusion and it is quite possible that the early administration of thyroid extract may have proved effective in warding off such changes.

In reviewing the postoperative roentgenograms of the heart and electrocardiograms of these patients, thus far no noteworthy changes have been detected. There has been no appreciable variation in the size of the cardiac silhouette, except in 2 patients with congestive failure where there has been a diminution in the transverse cardiac diameter (at least over 1 cm.) this decrease in size having occurred as the signs and symptoms of cardiac decompensation disappeared. In the anginal group we have observed no increase in the size of the heart shadow. In none of the patients have we seen any of the electrocardiographic changes that have been attributed to so-called myxedematous changes in the heart muscle, such as low voltage of all the complexes, inversion of the T waves and increased auricular-ventricular conduction time.

One or more of these variations have been noted in some of our patients but they were present prior to the operation. It is not improbable that the changes that are frequently attributed to the so-called myxedema heart will occur only when the disease is of long duration, as is the case in spontaneous myxedema, and that these abnormalities have been thus far warded off by the early feeding of thyroid extract following operation. Only one patient operated upon three years ago, has shown evidence of a moderately severe anemia.

SURGICAL MYXEDEMA

The symptoms and signs of surgical myxedema usually appeared within a period of four to eight weeks following the operation. These symptoms varied considerably in degree in different patients and usually were insidious in their development, although occasionally, for some unexplained reason, would appear quite suddenly. The most striking symptoms we have observed were those chiefly pertaining to changes in the facial appearance of the patient, such as puffiness of the face, including the eyelids, yellowish pallor of the skin, heaviness of the legs, tiredness, weakness, drowsiness and slowness of speech. As a rule, these symptoms were never very distressing and responded readily to the administration of dessicated thyroid extract. Postoperatively, the basal metabolic rate usually began to drop about the second week, and without the administration of thyroid extract, fell to about minus 30 to minus 40 per cent at the end of five or six weeks.

It was interesting to note that not infrequently, the symptoms and signs of surgical myxedema did not run strictly parallel to the drop in the metabolic rate; in other words, we encountered patients with basal metabolic readings of minus 30 per cent to minus 40 per cent, who exhibited clinically very few manifestations of myxedema and, on the other hand, a large percentage of our patients in whom repeated basal metabolic readings would be within limits that we recognized as normal or slightly below normal, would show unmistakable clinical manifestations of myxedema. In the latter group, the examination of the blood cholesterol usually showed marked elevation above the recognized normal figures. The level of the cholesterol content of the blood appeared to be a more sensitive index of the myxedematous state than the determination of the basal metabolic rate.

The not infrequent absence of any correlation between the clinical phenomena of artificially induced myxedema and the basal metabolism determination has led us to confirm the observations others have made in spontaneous myxedema, namely that the elevated blood cholesterol often appeared to be a more reliable

indication of the degree of hypothyroid function than the drop in the metabolic rate.

ADMINISTRATION OF THYROID EXTRACT

As has been mentioned, the symptoms of artificially induced myxedema usually responded readily to substitution therapy. As a rule, thyroid extract (Armour's) in a small dose of ¼ grain daily, was administered at the end of the fifth or sixth week when the basal metabolic rate approached between minus 30 to 40 per cent. We then prescribed dessicated thyroid in ascending doses to the highest point at which they could hold their clinical improvement to the symptoms of thyroid insufficiency. Our experience has been very much like that of the Boston workers in that we found very small doses were required to treat surgical myxedema, unlike spontaneous myxedema in which much larger doses are usually necessary. Practically all of our patients required a daily administration of only ¼ to ½ grain of the preparation of thyroid extract to relieve them of any signs or symptoms of myxedema.

In one patient we observed the effect of administering what was an excessive dose of thyroid extract. In this instance, thyroid extract had not been administered for a period of six months following the operation. At that time, because small doses of the thyroid extract afforded no relief of the very severe symptoms of myxedema which developed, the basal metabolic rate having dropped to unusually low levels, (minus 71 per cent and minus 75 per cent) we prescribed 5 grains of thyroid extract daily; after three days, the basal metabolic rate rose to plus 16 per cent and severe anginal pain appeared. When the dosage was reduced, this disappeared and the patient has since remained free from precordial pain upon the lower level of thyroid extract administration.

We have one patient in our series who up to very recently has not required the administration of thyroid extract. The operation was performed three years ago. Although his basal metabolic, two months following the operation had fallen to the level of minus 38 per cent and minus 44 per cent, the patient showed practically no clinical manifestations of myxedema and the signs and symptoms of congestive failure had disappeared in a most striking way. For some unexplained reason, three months following the operation the basal metabolic rate gradually rose to minus 16 per cent, minus 9 per cent and plus 3 per cent, and remained within these normal limits up to nine months following the operation without the administration of any thyroid extract, the blood cholesterol also remaining at a fairly normal level, 210 mg. per 100 c.c. It was thought that possibly some fragments of the thyroid gland had been left at the time of operation or that some aberrant thyroid tissue was present, but, all during this period the striking clinical improvement persisted and the patient remained free from any signs of congestive failure and was engaged in normal activity.

Curiously enough, eleven months following the operation, his basal metabolic rate began to drop again somewhat to the level of minus 16 per cent and the blood cholesterol rose to 340 and he began to show definite clinical evidence of myxedema for which he required thyroid extract.

It may be of some interest to record the present postoperative status of the basal metabolism and blood cholesterol levels of our successfully treated patients, following the administration of a daily ration of thyroid extract. In the congestive failure group the present basal metabolic readings average minus 14 per cent with the blood cholesterol levels averaging 356 mg. per 100 c.c. In the group with angina pectoris, the readings average minus 16 per cent with cholesterol readings averaging 310 mg. per 100 c.c. It may be of interest to note, this being especially true of our anginal group, although the blood cholesterol figures remain elevated, the basal metabolic rates are not strikingly lowered; only

moderately less than the preoperative metabolic rates. In other words, striking clinical improvement with relief of anginal pain has persisted even though the basal metabolic rate gradually rose to what amounted to practically preoperative level, following the feeding of thyroid extract.

POSTOPERATIVE RESPONSE TO DIGITALIS

In the congestive failure group, we observed an interesting difference to the response to digitalis therapy following operation. The adequate dosage of digitalis in patients with auricular fibrillation appeared to be less than that which was required prior to operation. It is doubtful if this can be explained on the basis of clinical improvement following the operation, inasmuch as those patients when readmitted in congestive failure would require smaller doses of digitalis to reduce the heart rate than was observed previous to the operation. The reduced amount of the drug required may possibly be attributed to one or more of three factors: (1) an altered absorption to the drug from the gastrointestinal tract; (2) an altered elimination of the drug, in other words, the factor of cumulation; and (3) an increased sensitivity to digitalis following thyroidectomy due to increased tone of the vagus nerve induced as a consequence of the development of myxedema. Further observations and study are essential in the consideration of this matter.

POSTOPERATIVE WATER RETENTION

We would like also to call attention to another clinical observation noted in postoperative behaviour of our group of patients with congestive failure. When these patients were readmitted to the hospital in congestive failure following operation, they exhibited evidence of striking water retention; the severity of the edema was out of all proportion to the rest of the clinical picture of congestive failure and more pronounced than that which was observed during the attacks of decompensation prior to the operation. This appeared especially true of accumulation of fluid in the serous cavities. Ascites or hydrothorax would not infrequently appear as initial manifestations of congestive failure. Thyroid extract in the small doses usually fed to those patients had no appreciable effect on the edema or the serous effusions but the mercurial diuretics seemed quite effective.

POSTOPERATIVE POLYNEURITIS

In this series, 2 patients presented a very unusual clinical picture of a severe type of peripheral polyneuritis, the etiology of which is still obscure. The onset of the symptoms in one patient was three months and in the other, six months after the operation. The symptoms were essentially severe pain in the hands and feet, coldness and weakness of the extremities, and other distressing parasthesias. In one patient, the deep reflexes, formerly hyperactive, disappeared, while in another, the deep reflexes were unaltered except for the Achilles tendon reflexes, which were not elicited. There was hyperesthesia to the touch of the point of a pin and light stroking of the skin over the area of the hands and feet; deep nerve tenderness was also present. The paresthesias were chiefly numbness and needle-like pain following the distribution of either the ulnar or median nerve. Bone conduction and the sense of position were unaffected. The administration of thyroid extract in small doses produced no relief of the symptoms. There were no signs suggestive of parathyroid deficiency, such as low blood calcium or positive Trousseau or Chvostek signs, nor was there any relief of the symptoms after the administration of viosterol or large doses of calcium. The blood picture revealed no significant abnormalities and a study of the gastric contents showed no changes except in one in whom an achylia was present. We have recently placed both of these patients on a high vitamin diet but the time elapsed since this regime has been instituted, has been too short to detect any improvement.

None of our other patients have shown a similar complication. It is possible that the cervical block anesthesia may be the causative factor of the parasthesia encountered in these 2 patients.

RESULTS OF OPERATION

Before reviewing our own results, it may be of interest to tabulate briefly the results of a statistical questionnaire submitted to twenty-six different clinics, where the operation of total ablation of thyroid gland has been performed for angina pectoris and congestive failure. The strikingly low operative mortality rate, 6.9 per cent, is of interest and this is of especial significance when one considers the very serious nature of the underlying pathological processes. Almost 80 per cent of the congestive failure group that survived the operation have apparently been benefited by the procedure, and a somewhat larger percentage in the anginal group have been either markedly or moderately improved.

Our own results are also briefly summarized below. There were 2 operative deaths, or 12.5 per cent, both in the congestive failure group. The first patient died from pulmonary edema twenty-four hours postoperatively; there was a coexistent bilateral nephrolithiasis and pyonephrosis and in view of our subsequent reference, should have been refused operation. The second patient was a hypertensive with congestive failure who suffered a cerebral hemorrhage toward the end of the operation, and died twenty-four hours later. There has been one later death in the angina group, or 6 per cent, not related to the operation, death occurring from a coronary closure ten weeks following the operation. No necropsies were obtained. Of the remaining 5 patients in the anginal group, 4 have been markedly improved, having remained practically free from precordial pain since operation. Occasionally after strenuous activity, especially in cold weather, slight pain will recur, but these attacks usually are not severe and do not require the administration of nitroglycerin. One of these patients was a moderately severe diabetic, before operation carrying a persistently high blood sugar. On the fourth day postoperatively, the urine became sugar-free and although the diet has remained unchanged, the urine has remained sugar-free, although there has been no corresponding change in the blood level. One anginal patient, though greatly relieved of his attacks of precordial pain, has been incapacitated because of peripheral neuritis.

Of the remaining 8 patients of the congestive failure group, 3 have shown practically no improvement since operation. Two have continued with progressive decompensation, the other, suffering from syphilitic aortic insufficiency, has had repeated hospital admissions for a questionable congestive failure. The other 5 patients have received marked benefit from the operation, with no recurrence of episodes of decompensation, and return to normal activity has been achieved.

CASE REPORTS

Case 1. J. H., forty-nine years of age, white male, janitor, has had symptoms of heart disease for the past twelve years. In 1926, he was first admitted to a hospital for congestive failure. From 1930 to January, 1934 he had 6 admissions to Bellevue Hospital because of severe decompensation. During the intervals he was observed in the cardiac clinic and was never completely free from symptoms.

He has had nocturnal dyspnea, exertional precordial distress, chronic cough and swelling of the abdomen, and edema of the ankles and legs in varying degrees for four years.

Physical examination revealed a thin white male with marked dyspnea and orthopnea, and slight cyanosis; large pulsating veins of the neck; rales in base of right lung and a left hydrothorax, which was tapped twice. There was a systolic retraction at the apex as well as of entire right chest. A diffuse precordial impulse, a presystolic thrill, and presystolic and systolic murmurs at the apex, and a diastolic murmur at the base were present. The apex was in the sixth space at the anterior axillary line. There was a slow auricular fibrillation. The

blood pressure was 116/90. The liver was four fingers breadth below the costal margin. Pitting edema of the ankles and legs was evident.

A teleroentgenogram showed cardiac enlargement in all diameters, with a marked accentuation of the left auricular and ventricular curves.

Electrocardiogram showed a slurred Q.R.S. complex, slow auricular fibrillation and a digitalis effect.

Diagnosis: Rheumatic heart disease; mitral stenosis; aortic insufficiency; auricular fibrillation; Class III.

The prognosis without operation was unquestionably poor. The intervals between hospital admissions were becoming shorter and his condition in the intervals was not good enough to enable him to carry on normally.

Total thyroidectomy was performed on February 9, 1934 under cervical block anesthesia. The postoperative course was uneventful. The patient was allowed out of bed on the ninth day. His general condition improved rapidly. Precordial distress and heart consciousness completely disappeared. Edema of the ankles completely disappeared with administration of digitalis and salyrgan. Ten weeks postoperatively he had a recurrence of congestive failure and was readmitted to the hospital where he improved rapidly with rest in bed, digitalis and salyrgan. There were no further readmissions until eighteen months postoperatively, when he was readmitted for a right hernioplasty in October, 1934. His postoperative course was uneventful. He has been followed in the cardiac clinic since that time.

The basal metabolism rates were as follows:

	Per Cent
1 week prior to the operation	+11
1 week after	+17
3 weeks	−15
4 weeks	−25
7 weeks	−27
9 weeks	−42
14 weeks	−39
4 months	−27
5 months	−30
6 months	−24

At this point he was started on his thyroid feeding at a quarter of a grain a day; this was increased to a half a grain a day three weeks later, and has been continued at that amount up to the present. The basal metabolic rate two years postoperatively is −30 per cent.

At present, three years after total thyroidectomy, he is able to walk four blocks at a moderately rapid pace, without symptoms of distress and is able to go up one flight of stairs. He has not been readmitted to the hospital wards for over twenty-four months, a longer period of freedom from hospitalization than he had enjoyed for the preceding four years. He is free from palpitation and heart consciousness, and the other unpleasant symptoms of congestive failure.

Case II. C. S., forty year old white male, a plumber, first noticed symptoms of heart disease and cardiac pain in May, 1933 and had admissions to Bellevue Hospital because of severe decompensation. The dyspnea was constant; he was not able to walk more than half a block; and he slept on four pillows. A severe precordial "ache" had been present for six months, which radiated down the outer side of both arms. These attacks would occur about every two or three weeks and would last for two or three days. Had noticed forceful irregular precordial palpitation for eight months. There had been edema of the ankles, legs and sacrum.

Physical examination on admission revealed a well preserved middle aged male, with marked dyspnea and orthopnea. There were mois rales at both bases and a left hydrothorax. The apex was in the sixth intercostal space at anterior axillary line; P_2 was greater than A_2; and a rumbling apical systolic and diastolic murmur were heard. Auricular fibrillation was present. His blood pressure was 130/96. The liver was five fingers breadth below the costal margin. Edema of the legs and ankles was also evident.

An electrocardiogram showed auricular fibrillation, with left ventricular premature contractions and myocardial changes.

Diagnosis: Chronic rheumatic heart disease; essential hypertension; mitral stenosis; auricular fibrillation, Class III.

The prognosis without operation was unquestionably poor. While there had been a moderate degree of compensation restored following his frequent periods of hospitalization, he had never been able to regain normal activity.

Total thyroidectomy was performed on February 9, 1934, under cervical block anesthesia, no supplementary anesthesia being required.

There has been no recurrence of symptoms of congestive heart failure.

The basal metabolic rates were as follows:

	Per Cent
2 days prior to the operation	+ 2
2 weeks after the operation	− 8
5 weeks	−11
6 weeks	−23
7 weeks	−38
8 weeks	−44
10 weeks	−48
12 weeks	−16
14 weeks	− 9

At the eleventh month the rate dropped to minus 16 per cent, and he began to appear very myxedematous, and for the first time thyroid extract was administered, ¼ grain being given daily.

The blood pressure has been very interesting; during the periods of severe decompensation before operation the blood pressure would fall as low as 128/84, rising with improvement of symptoms to 170/120 approximately; at the time of operation the blood pressure was 130/96. This rose gradually following the operation to 150/100; at the end of the first month, 175/100; at the end of three months, and from that time until the present (thirty-six months postoperatively) it has ranged between that figure and 218/125.

Twenty-nine months following operation, he was working, and there had been no recurrence of symptoms of congestive failure, despite the fact that he frequently overindulged in the use of alcohol, strongly against our advice. There had been no recurrence of attacks of paroxysmal auricular fibrillation.

The result in this particular patient had been very striking, as he had been enabled to return to active life and to carry on rather heavy physical labour.

In July, 1936 he overindulged in the use of alcohol, became disoriented and died shortly thereafter.

Necropsy revealed an old rheumatic mitral stenosis with focal calcification and ulceration of mitral valve; organized myocardial infarction of anterior portion of interventricular septum and posterior left ventricular wall; severe coronary atherosclerosis with occlusion of the two left anterior descending branches, partial occlusion of right coronary and left circumflex branch with organized thrombus; also bilateral thrombosis of internal carotid arteries. It is remarkable that with such a diffuse multiple coronary infarction, he died a painless death. There were no symptoms of congestive failure prior to this last admission.

Case III. A. E., sixty-eight year old white female, houseworker and dressmaker, complaining of symptoms of heart disease which had been present since 1926, following acute massive coronary thrombosis with pulmonary infarction. Since that time she has had ten admissions to various hospitals because of cardiac decompensation. Between these periods spent in hospitals her condition has been quite good and she has been able to carry on with her normal occupation. However, during the past three years, the free periods have been much shorter in duration, and not quite as free from symptoms.

The history contained the following points of interest: exertional dyspnea present for eight years, repeated attacks of paroxysmal nocturnal dyspnea; inability to lie flat for eight years, and at present sleeping on five pillows. Precordial pain was experienced only with the first attack. Edema of the legs, ankles, sacrum and abdomen had been present varying in degree for eight years.

Physical examination revealed a thin elderly dyspneic, orthopneic female. The neck veins were distended and pulsating. There was a diffuse precordial impulse; the apex was in the sixth space at the anterior axillary line; A_2 greater than P_2, normal sinus rhythm, and a loud blowing apical systolic murmur. Her blood pressure was 176/100. The liver was four fingers breath below the costal margin. Moderate ankle, leg and sacral edema was present. There was a partial prolapse of the uterus.

Electrocardiogram showed normal sinus rhythm with marked left ventricular preponderance, and evidence of myocardial degeneration.

Diagnosis: Arteriosclerotic heart disease; essential hypertension; old coronary infarction; normal sinus rhythm; Class III.

Total thyroidectomy was performed on February 15, 1934, under cervical block anesthesia. No technical difficulties were encountered.

The postoperative course was uneventful; the patient was out of bed on the fifth day. The dyspnea was considerably lessened by the end of the first week.

The patient was readmitted during the eleventh postoperative week with symptoms of congestive failure which improved rapidly with digitalis and salyrgan. The symptoms

were mainly of water retention and have been on each of the subsequent admissions. In the eighth month she was readmitted again in moderate failure and remained in the hospital for six weeks; and again readmitted at the end of thirteen and a half months with congestive failure. The failure on each of these readmissions has always been due to an accumulation of fluid in the abdomen, strikingly out of proportion to the other symptoms of congestive failure. In the twentieth postoperative month she was readmitted with signs of congestive failure and ascites. Her course was progressively downward and she died December 26, 1935.

Necropsy revealed an old coronary infarct of the anterior wall of the left ventricle with an aneurysmal dilatation of the left ventricular wall and a left pulmonary infarct. There was bilateral hydrothorax, and chronic passive congestion of the liver and spleen, with ascites.

Case IV. M. H., fifty years old, colored female, houseworker, first noticed symptoms of heart failure in January, 1932. This initial attack of decompensation lasted only a short time, and following this she was practically free from symptoms until June, 1933 when there was a severe break in compensation from which she never fully recovered, and was hospitalized from June, 1933 until the time of operation in April, 1934.

Physical examination revealed a well developed middle aged Negress, markedly dyspneic and orthopneic, with dilated and pulsating cervical veins. A few rales were heard at the bases of both lungs. There was a heaving pulsation at the apex which was in the seventh space in midaxillary line; A_2 was greater than P_2 and a loud systolic and short diastolic murmur at the apex; the sinus rhythm was normal with occasional extra systoles. Her blood pressure was 180/120. The liver edge was below the umbilicus and pulsating. No ascites was present, but there was marked edema of the ankles, sacrum and abdomen.

Diagnosis: Rheumatic heart disease; essential hypertension; mitral stenosis; normal sinus rhythm; Class III.

The prognosis was unquestionably poor, as there had been practically no improvement at any time in the eight months of hospital treatment. There was very little cardiac reserve power present, which was evidenced by the lack of response to treatment. The operative risk was considered as poor, and the procedure was undertaken only as a last resort.

Total thyroidectomy was performed on March 13, 1934, under cervical block anesthesia. The immediate postoperative improvement was extremely striking. The patient felt much more comfortable than she had been for eight months. The improvement however lasted for only two weeks, then symptoms of congestive failure recurred as it had been before the operation. Up to the present time, thirty-three months postoperative, there has been practically no further changes.

The basal metabolic rates were as follows:

	Per Cent
Prior to the operation	− 2
2 weeks after	−17
4 weeks	−35
6 weeks	−26
7 weeks	−28
9 weeks	−23
14 weeks	−22

This case is regarded as a complete failure. The remarkable early improvement was interesting and occurred apparently long before there was any appreciable drop in the metabolic rate.

Case V. J. M., fifty-nine year old white male, Customs' inspector, had his first attack of precordial pain in 1929; there were several additional attacks during that year, with a gradual increase in frequency and severity, until September 1933, when he experienced an unusually severe attack, diagnosed as an acute coronary occlusion. For the following six months he was practically bedridden because of pain. There was one more coronary closure in February, 1934, and he was thus forced to give up his normal occupation as a lieutenant in the Customs' Service, in June, 1933 because of exertional pain.

Physical examination revealed a well developed and nourished elderly white male. The lungs were clear. There was no precordial pulsation or thrill. The heart sounds were rather distant but no murmurs heard. His blood pressure reading was 134/82. The liver was not palpable. No ascites or edema was evident.

X-ray picture revealed a slight enlargement of the heart and a moderate dilatation of the aorta. The electrocardiogram showed normal sinus rhythm, left ventricular preponderance and myocardial changes associated with coronary artery disease.

Diagnosis: Arteriosclerotic heart disease; multiple myocardial infarction; dilatation of the aorta; Class III.

The patient had been under observation for one month, during which time the symptoms were obviously becoming more severe, nor had there been any improvement for some six months despite constant medical care and treatment. The outlook appeared to be hopeless unless relief could be obtained through total thyroidectomy.

Total thyroidectomy was performed on March 15, 1934, under cervical block anesthesia. The postoperative course was uneventful. There were no further attacks of pain from the time the operation was completed. There has been no return of dyspnea, heart consciousness or palpitation. Signs of myxedema appeared at the end of the first month, but were not severe until the fourth month. Thyroid feeding was not started until the twenty-third week, at which time the basal metabolic rate had fallen to minus 71 per cent.

Three years after the operation, the patient remains free from anginal attacks. However, as in Case XIII in this series, a severe peripheral neuritis developed during the eighth month affecting the upper extremities on both sides which prevents the patient from living normally.

Case VI. S. B., fifty-four year old white male, an insurance agent, complained of symptoms of cardiac pain which have been present since 1925, when he had his first coronary vessel closure. In November, 1928 he had another coronary occlusion, and there was a third coronary vessel closure in December 1933.

Physical examination on admission showed an obese white male, emphysematous chest; heart slightly enlarged to the left, heart tones distant; no murmurs were heard; normal sinus rhythm. His blood pressure was 128/80. The liver margin was one finger's breadth below the costal margin. No ascites or edema was present.

X-ray picture revealed a slight enlargement of the transverse diameter of the heart and enlargement of the aorta. Electrocardiogram showed normal sinus rhythm, left axis deviation and marked myocardial damage.

Diagnosis: Arteriosclerotic heart disease; multiple myocardial infarctions; normal sinus rhythm; angina pectoris; Class III.

The prognosis without operation was unquestionably very poor. The symptoms were becoming gradually much more severe and relief could be obtained only by the use of morphine.

Total thyroidectomy was done on March 20, 1934, under cervical block anesthesia. The postoperative course was uneventful. There was no recurrence of the pain after the operation and there has been no real attack up to the present time. There has been occasional mild sensations of oppression over the precordium following excessive exercise.

We feel that this case has been quite satisfactory as it has enabled the patient, who had been compelled to give up his occupation for seven years, to return to a comparatively normal life.

Case VII. L. C., thirty-six year old male, machine operator, first noticed symptoms of heart disease in March, 1933, followed by two attacks of congestive failure which required hospitalization. The patient had an attack of acute rheumatic fever in 1916. In 1933 he began to suffer from dyspnea, orthopnea, precordial distress, forceful and irregular palpitation. There was a moderate degree of right upper quadrant tenderness, tenderness over the right renal area; diurnal frequency of micturition and nocturia.

Physical examination on admission revealed a poorly nourished dyspneic, orthopneic, cyanotic middle aged male. The neck veins were dilated and there was a right hydrothorax. The heart was greatly enlarged, the apex being in seventh space in the midaxillary line. Systolic and diastolic murmurs were heard at the apex and a diastolic murmur at the base; auricular fibrillation was present. His blood pressure was 180/110. The liver edge was three fingers breadth below the costal margin, tender and pulsating. No ascites or edema was noted.

An electrocardiogram showed a very low voltage and auricular fibrillation. The blood non-protein nitrogen was 45 mg. Urinalysis showed albumin 4 plus, and pus cells. Pyelograms showed bilateral renal calculi. Kidney function dye tests showed a marked renal impairment.

Diagnosis: Rheumatic heart disease; mitral stenosis; aortic insufficiency; auricular fibrillation; Class III. Bilateral nephrolithiasis and pyonephrosis.

The prognosis was extremely poor considering the extent of the renal involvement. There had been no improvement in the condition following admission, and which was rapidly becoming worse. The operative risk was considered as being very poor.

Total thyroidectomy was performed on March 20, 1934, under cervical block anesthesia. The condition of the patient was poor throughout.

The pulse varied from 80 to 140. There were no technical difficulties encountered. The gland was normal both grossly and microscopically.

The patient's condition was very poor at the close of the operation, and went rapidly downhill. Pulmonary edema set in and the patient died twenty hours postoperatively. No autopsy was obtained.

Case viii. L. M., sixty-two year old white female, hospital attendant, had two attacks of acute rheumatic fever, the first at seven years of age, the second at fourteen years. Symptoms of congestive failure were first noticed in 1927. During the following eight years there were 13 periods of hospitalization, of an average duration of two months. She was practically a bed invalid for this whole period of time, as there was never a sufficient degree of compensation obtained to permit her carrying on any activity.

Physical examination showed an obese, elderly, dyspneic, orthopneic female, with cyanosis of lips and engorged veins of the neck. Moist rales were heard at both bases. The apex was in the sixth intercostal space at the anterior axillary line; P_2 greater than A_2, a double apical and an aortic diastolic murmurs were heard; there was a slow auricular fibrillation. Her blood pressure was 140/95. The liver was four fingers breadth below the costal margin and tender, irregular and nodular, but not pulsating. Massive edema of ankles, legs and over sacrum with many large varices in both legs were observed.

X-ray picture showed a marked enlargement of the heart in all diameters, with slight dilatation and moderate sclerosis of the aorta. Electrocardiogram showed slow auricular fibrillation and low voltage.

The basal metabolism rate was plus 1 per cent.

Diagnosis: Rheumatic heart disease; mitral stenosis; aortic insufficiency; auricular fibrillation; Class iii. Bilateral varicose veins.

The prognosis without operation was considered very poor. The condition had not been benefited by any form of treatment to an extent which would permit her to regain a useful degree of compensation, even after long periods of hospitalization.

Total thyroidectomy was performed on April 4, 1934, under cervical block anesthesia. Apart from slight secondary hemorrhage and a mild degree of tetany, controlled by calcium and viosterol, the convalescent course was quite satisfactory. The patient was out of bed on the fourteenth day. There was no further precordial distress.

There have been two readmissions to the hospital since operation, the first when she developed a widespread lobular pneumonia, seven months postoperatively. Despite an extensive consolidation and a severe general reaction with a high fever, the heart showed very few signs of decompensation and the patient came through the illness without difficulty. Eighteen months postoperatively, she was readmitted to the hospital with congestive failure, which cleared up with bed rest and salyrgan. At present she is taking digitalis 0.1 gm. q.d. to control the auricular fibrillation and ½ grain thyroid extract.

We feel this case to be a very striking result. A rather elderly woman has been enabled to regain a considerable amount of normal activity, after being a severe cardiac invalid for practically seven years, the last five of which were spent almost constantly in bed. Further the patient suffered from a widespread lobular pneumonia without any evidence of cardiac failure.

Case ix. P. K., forty-six year old white male, a fruit dealer, since 1932 had been suffering from cardiac pain radiating from his wrist up toward the left shoulder, relieved by rest, nitroglycerine and amyl nitrite. There were no attacks suggesting coronary occlusion. Following the first attack of precordial pain, he was forced to give up his work because of the steadily increasing severity of the attacks. The three months prior to operation the patient spent in bed and suffered two or three attacks daily and nightly. For the past two years, he had been treated in the diabetic clinic as a moderately severe case of diabetes mellitus; he had a constantly high blood sugar and glycosuria but had not been given insulin due to the angina pectoris.

Physical examination on admission revealed a well nourished male, slightly dyspneic. The chest was emphysematous. The heart sounds were distant but of fairly good quality, and there was a normal sinus rhythm. His blood pressure was 138/60. The liver was not enlarged. No edema was present.

Roentgenogram showed slight enlargement of the heart and left ventricular curve; aorta not enlarged. Electrocardiogram showed low slurred R wave in the first and second leads,

with low voltage. The basal metabolism rate was plus 11 per cent.

Diagnosis: Arteriosclerotic heart disease; coronary sclerosis; angina pectoris; normal sinus rhythm; Class III. Diabetes mellitus.

The prognosis without operation was very poor, as he had been at bed rest for three months with the pain becoming gradually more frequent and severe.

Total thyroidectomy was performed on April 17, 1934, under cervical block anesthesia. The postoperative course was complicated by mild symptoms of tetany which were controlled by calcium and viosterol. The associated diabetes in this case was quite interesting; he had been on a diet of 120 gm. carbohydrates, 60 gm. fat, and 60 gm. protein; this diet was not changed following the operation. The preoperative blood sugar had ranged from 185 to 224 mgms. Two days after the operation the blood sugar had returned to within normal limits and the urine for the first time in three years became sugar-free. While the blood sugar has since returned to its previous high level the urine has remained constantly sugar-free during the entire postoperative period. It would seem that the kidney threshold of the sugar excretion had been raised.

We feel this case to be a very striking result. There has been no recurrence of cardiac pain up to the present time. During cold weather or following overexertion the patient experiences a mild feeling over the precordium. This has never been severe and it is of an entirely different nature to the pain before operation.

Case X. R. S., forty year old white male, plumber, since 1930 had cardiac pain with typical radiation down the left arm, relieved by rest and nitroglycerin. In January, 1932 there was an acute coronary occlusion, following which the cardiac pain became much more severe and frequent, and he was thus forced to give up his normal occupation.

Physical examination on admission showed a well developed middle aged white male, chest clear, heart sounds clear; no murmurs heard. The pulse rate was 85 and regular. His blood pressure was 115/78.

Electrocardiogram showed normal sinus rhythm and myocardial changes from an old coronary vessel closure.

Diagnosis: Arteriosclerotic heart disease; coronary vessel closure; normal sinus rhythm; angina pectoris; Class III.

The prognosis without operation was very poor. The pain was becoming more severe and the attacks more frequent. He had been able to secure temporary relief by the use of amyl nitrite and nitroglycerine, but was unable to ward off their occurrence.

Total thyroidectomy was performed on May 12, 1934, under cervical block anesthesia. The postoperative course was uneventful. There has been no recurrence of pain from the time the operation was completed up to the present.

This case is considered as outstandingly successful. There has been no return of the pain since the operation, despite the fact that the patient has indulged in a great deal of exercise, against our advice strongly to the contrary.

He was carrying on rather heavy physical labor and died suddenly April, 1936. Necropsy revealed a complete gradual obliteration of both coronary arteries, and an organized myocardial infarction of the anterior portion of the intervalvular septum and posterior left ventricular wall.

It is remarkable that with multiple myocardial infarction due to repeated coronary vessel closure, he died without cardiac pain and oppression.

Case XI. L. C., sixty-three year old white male, clerk, presented symptoms of cardiac pain since 1930, when he had substernal oppression and exertional pain. However in 1932 he had a coronary occlusion; following this the pain became much more frequent and severe and he was forced to give up his work. He took as much as 150 $\frac{1}{100}$ grain nitroglycerin tablets per week. Following the coronary closure, he began to have decubital and nocturnal pain.

Physical examination on admission revealed a dyspneic, orthopneic elderly male, with slightly distended and pulsating cervical veins. The apex was in the sixth intercostal space 14 cm. to the left of midsternal line. An apical systolic murmur was heard; A_2 greater than P_2. The pulse rate was regular. The peripheral vessels were tortuous and thickened. His blood pressure was 160/110. The liver edge was two fingers breadth below the costal margin. There was no ascites or edema.

Skiagram revealed a moderately enlarged heart. Electrocardiogram showed inverted T waves in all leads, left axis deviation, partial A-V block, and defective bundle branch conduction.

Diagnosis: Arteriosclerotic heart disease; essential hypertension; coronary sclerosis; angina pectoris. Class III.

Prognosis without operation was considered as being poor. Purely medical measures were inadequate to prevent the attacks of pain which were becoming somewhat more severe.

Total thyroidectomy was performed on May 15, 1934, under cervical block anesthesia. The postoperative course was practically uneventful except for a pulmonary embolism. There was complete freedom from pain until the end of third week, when the patient began to have one or two attacks a day. These were of much less severity than the previous attacks and also relieved by nitroglycerin. In the eighth week, the pain began to be somewhat more severe and signs of decompensation appeared. Eleven weeks after the operation, the patient had a seizure while walking on the street and died immediately. No postmortem examination could be obtained, but it is practically certain that there was another coronary vessel closure.

Case XII. H. B., fifty-four year old white male, policeman, had symptoms of cardiac pain since 1932, gradually increasing in severity. For the past year he had not been able to walk more than one block without resting, and he also had frequent attacks of paroxysmal nocturnal dyspnea. Edema of a mild degree had been present for two years. One kidney had been removed eight years previously, because of stones.

Physical examination revealed a dyspneic, orthopneic, elderly male, with distended veins of the neck. Rales were heard at both bases. The apex was in the sixth intercostal space 15 cm. to the left from midsternal line; P_2 was greater than A_2; a loud blowing apical systolic murmur and slow auricular fibrillation were evident. His blood pressure was 190/130. The liver edge was four fingers breadth below the costal margin. A moderate degree of edema of ankles and legs was present.

An electrocardiogram showed auricular fibrillation and marked left ventricular preponderance.

Diagnosis: Arteriosclerotic heart disease; essential hypertension; auricular fibrillation; congestive failure; Class IIB.

The prognosis was very poor as to the patient's ability of continuing his occupation, and it was hoped that a total thyroidectomy might enable him to resume his normal activity. It was obvious that he was on a verge of congestive failure.

Total thyroidectomy was performed on May 19, 1934, under cervical block anesthesia, the operation lasting three-quarters of an hour. There was no injury to the recurrent laryngeal nerves. The condition of the patient was good up to the end of the operation, but as the skin clips were being applied he went into a comatose state and died immediately. A postmortem examination could not be obtained; but a spinal tap done at the time yielded a hemorrhagic fluid, and it was felt quite certain death was due to a cerebral hemorrhage.

Case XIII. M. L., fifty-three year old white female, milliner, complained of symptoms of heart disease for three and one-half years with two bouts of congestive failure. She was followed in the cardiac clinic and it was decided to submit her to the operation of total thyroidectomy, in the hope that she might eventually be able to return to work.

Physical examination revealed a dyspneic, cyanotic, middle aged female with engorgment of the veins of neck. There were moist rales at both bases. The apex impulse was felt in the sixth intercostal space 13 cm. to the left from the midsternal line; P_2 was greater than A_2; a systolic and a diastolic murmur were heard at the apex, but there was normal sinus rhythm. Her blood pressure was 190/120. Slight pretibial edema was evident.

Diagnosis: Rheumatic heart disease (inactive); essential hypertension; mitral stenosis; sinus arrhythmia; Class IIB.

Total thyroidectomy was performed on August 29, 1934, under cervical block anesthesia. The postoperative course was uneventful and the patient was out of bed on the twelfth day. There was immediate relief of the palpitation, precordial pain and heart consciousness. The signs of congestive failure had disappeared by the end of the first week. Three and one-half months after the operation, at a time when she was able to resume her work, she developed signs and symptoms of a peripheral neuritis involving both the upper and lower extremities, on both sides, which have persisted up to the present time. We feel that this case, were it not for the unfortunate complication of the peripheral neuritis, would be strikingly successful. She is now thirty months postoperative and is completely free of any symptoms or signs of congestive heart failure.

Case XIV. R. R., forty-seven year old white male, cabinet maker, complained of cardiac pain for eight months. There had been no major attacks suggestive of coronary occlusion, but the attacks had been occurring more frequently and at more regular intervals.

Physical examination revealed a rather obese, well developed male. The chest was clear. The apex was felt in the fifth intercostal space 12 cm. to the left of the midsternal line. The heart sounds were distant but clear. The pulse rate was regular. His blood pressure was 110/80.

Roentgenogram showed a moderate left ventricular hypertrophy; the aorta was normal. Electrocardiogram showed normal sinus rhythm and myocardial changes suggestive of coronary sclerosis.

Diagnosis: Arteriosclerotic heart disease; coronary sclerosis; angina pectoris; Class III.

The prognosis without operation was poor. There had been no diminution in the frequency or the severity of the attacks, despite rest and adequate medical treatment. The attacks were relieved but not prevented by the use of amyl nitrite. Inasmuch as there had been no definite coronary occlusion, it was felt that a good result should be obtained.

Total thyroidectomy was performed on August 29, 1934, under cervical block anesthesia. The voice became quite husky at the end of the operation until suddenly on the third postoperative day, edema of the larynx developed, causing a complete absence of motion of the vocal cords. However in five months time, the vocal cords moved in full excursion.

Sixteen months postoperative, the patient was working from six to eight hours a day, doing rather heavy carpentry. In December, 1936, the patient wrote stating that he was still engaged in heavy work with practically no discomfort.

Case XV. T. L., forty-nine year old white male, a porter, had symptoms of congestive failure since January, 1934 and has had three admissions to Bellevue Hospital because of decompensation. Each time recovery followed rapidly with rest and treatment, and his compensation has been restored sufficiently to enable him to return to his occupation.

Physical examination on admission revealed a dyspneic, orthopneic, cyanotic middle aged male, with dilated and pulsating cervical veins. A right hydrothorax was present and moist rales were heard in both lungs. The apex was palpable in the sixth intercostal space 18 cm. to the left of midsternal line. Austin Flint and aortic diastolic murmur and auricular fibrillation were also manifested. His blood pressure was 160/95. The liver edge was four fingers breadth below the costal margin. Moderate pretibial edema was present.

Teleroentgenogram showed a dilatation and sclerosis of the aorta and a markedly enlarged heart. Electrocardiogram showed auricular fibrillation and bundle branch block. The blood Wassermann was 4 plus.

Diagnosis: Syphilitic heart disease; aortic insufficiency; auricular fibrillation; Class III.

The prognosis without operation was poor, the free intervals were becoming shorter and the response to treatment a little slower. Total thyroidectomy was performed on August 30, 1934, under cervical block anesthesia. The postoperative course was uneventful. There have been five admissions since the operation fifteen months previously. Each time there has been small amounts of fluid in the right chest and abdominal cavity and a moderate degree of edema. Patient died suddenly November 17, 1935.

Case XVI. G. T., thirty-nine year old white female, houseworker, had symptoms of heart disease for more than six years with four admissions to Bellevue Hospital during that time because of cardiac decompensation. Her condition in the intervals had been only fair, and for the last year and a half she had not been able to carry out her household tasks.

Physical examination on admission revealed a dyspneic, cyanotic, middle aged female with engorged veins of neck. There were moist rales at both bases. The apex was palpable in the sixth intercostal space 14 cm. to the left of the midsternal line. Systolic and diastolic murmurs at the apex and a diastolic murmur at the base, with slow auricular fibrillation were heard. Her blood pressure was 130/95. The liver was five fingers breadth below the costal margin, tender and pulsating. There was moderate pretibial edema of legs and ankles.

Teleroentgenogram showed a tremendously enlarged heart; the electrocardiogram showed auricular fibrillation and right axis deviation. The basal metabolism rate was plus 2 per cent.

Diagnosis: Rheumatic heart disease; mitral stenosis; aortic insufficiency; auricular fibrillation. Class IIB.

The patient had always compensated fairly quickly with hospital treatment, but not enough to allow of her leading an active life. It was

hoped that the operation would enable her to do this.

Total thyroidectomy was performed on September 18, 1934, under cervical block anesthesia. No technical difficulties were encountered. The postoperative course was entirely uneventful. At present, thirty months postoperatively, the patient is able to do all the housework and the cooking for four people, without any discomfort. We feel that this case is an excellent result.

SUMMARY AND CONCLUSIONS

Our studies to date comprising but 16 cardiac patients who have been followed for a period from twelve to thirty-two months are offered only as material to be added to the growing mass from which ultimately conclusions regarding the essential value of total thyroidectomy for the treatment of heart disease will be drawn.

A group of patients suffering from cardiac decompensation or anginal pectoris, intractable to the usual medical measures, can be distinctly helped by total ablation of the thyroid gland. The benefit produced is sufficiently great in a large enough pro-

Table I

Results of Answers to Statistical Questionnaire on Total Thyroidectomy for Heart Disease

This operation has been done in 26 clinics.	
Total number of operations	273
Operative mortality	6.9 per cent
Complications	
Parathyroid tetany	8
Transient, mild, controlled by viosterol and calcium therapy.	
Recurrent laryngeal nerve paralysis	13
4 of these temporary.	

Table II

Total Thyroidectomy for Congestive Heart Failure

Results Obtained by Questionnaire	
Number of Cases	173
Deaths	
Immediate	16– 9.3%
Late—not related to the operation	30–11.5%
Clinical Results in 124 Patients	
Markedly improved	52–41.9%
No recurrence of the signs or symptoms of congestive failure. Able to work.	
Moderately improved	48–38.7%
Attacks of congestive failure less frequent and less severe. Unable to work.	
No improvement	24–19.3%

Table III

Total Thyroidectomy for Angina Pectoris

Result Obtained by Questionnaire	
Number of Cases	100
Deaths	
Immediate	3– 3%
Late—not related to the operation	15–15%
Clinical Results in 82 Patients	
Markedly improved	42–51.2%
No pain. No nitroglycerine. Normal activity.	
Moderately improved	33–40.2%
Mild attack of pain at irregular intervals. Occasional use of nitroglycerine.	
No improvement	7– 8.5%

Table IV

Total Thyroidectomy for Angina Pectoris

Operated Cases	
Number of Cases	6
Deaths	
Immediate	0
Late not related to the operation	2
Coronary occlusion, 10 weeks postoperative; and coronary sclerosis, 2 years postoperative.	
Markedly improved	3
No pain. No nitroglycerine. Normal activity.	
Moderately improved	1
Mild attacks of pain, at irregular intervals. Occasional use of nitroglycerine.	
Slightly improved	0
Mild attacks of pain daily. Nitroglycerine as before the operation.	
No improvement	0
Complications	
Parathyroid tetany	1
Transient, mild, controlled by viosterol and calcium therapy.	
Recurrent laryngeal nerve paralysis	1
Complete bilateral paralysis appeared on the third postoperative day. Normal movement returned by the end of the fourth month.	

Table V

Total Thyroidectomy for Congestive Heart Failure

Operated Cases	
Number of cases	10
Deaths	
Immediate*	2
Late, not related to the operation	1
from alcoholism 2½ years later.	
Markedly improved	3
No recurrence of the signs or symptoms of congestive failure. Able to work.	
Moderately improved	2
Attacks of congestive failure less frequent, and less severe. Unable to work.	
No improvement	2
Condition unchanged.	
Complications	
Parathyroid tetany	1
Transient, mild, controlled by viosterol and calcium therapy.	
Recurrent laryngeal nerve paralysis	0

* 1 death from a cerebral hemorrhage immediately following the operation; 1 death from pulmonary edema within 24 hours.

SUMMARY OF PATIENTS WITH CONGESTIVE FAILURE

Case No.	Age	Sex	Date of operation	Diagnosis	Symptoms Prior to Operation	Basal Metabolism			Blood pressure	Results	Comments
						Post-operative, per cent	Myxedema, per cent	On thyroid therapy, per cent			
1	49	M.	2/9/34	Rheumatic heart disease; mitral stenosis, aortic insufficiency, auricular fibrillation.	Marked dyspnea and repeated severe bouts of congestive failure. Paroxysmal nocturnal dyspnea, exertimal precordial distress.	+38(?) +17	−42	−15	116/90	Markedly improved.	Ambulatory, comfortable for 19 months.
2	40	M.	2/9/34	Arteriolosclerotic heart disease; essential hypertension, auricular fibrillation.	Repeated periods of congestive failure since May 1933. Constant dyspnea, orthopnea, precordial palpitation.	+ 2	−48	−16	150/100	Markedly improved for 2½ years when death occurred from alcoholism.	Patient now working, there has been no recurrence of symptoms of congestive failure. He has been enabled to return to active life and to carry on heavy physical labor.
3	68	F.	2/15/34	Areriolosclerotic heart disease; essential hypertension; normal sinus rhythm.	Repeated bouts of decompensation since 1926. Attacks of paroxysmal nocturnal dyspnea for 8 years. For the past year she had not been able to walk more than 1 block without resting. Edema of legs had been present varying in degree for 8 years.	+13	−22	−19	176/100	No improvement.	Readmitted to hospital 3 times since operated on, for accumulation of fluid in abdomen which improved rapidly with digitalis and salyrgan.
4	50	F.	3/13/34	Rheumatic heart disease; mitral stenosis, normal sinus rhythm; essential hypertension; congestive failure.	Dyspnea and orthopnea, with congestive failure and edema of legs, requiring hospitalization since June 1933. Congestive failure never completely cleared with bed rest, salyrgan and digitalis.	− 2	−35	−22	180/120	No improvement.	This case is a complete failure. Patient still is in congestive failure.
7	36	M.	3/20/34	Rheumatic heart disease, mitral stenosis, aortic insufficiency, auricular fibrillation; bilateral nephrolithiasis and pyonephrosis.	Dyspnea and congestive failure with right hydrothorax for past year. Nocturnal dyspnea for past year. Tenderness over right renal area, with nocturia and polyuria. Kidney function dye tests showed marked renal impairment. Albumin ++++ with clumps of pus cells.	− 4			180/110	Immediate postoperative fatality.	Marked renal impairment in case of congestive failure is contraindication for operation. Pulmonary edema set in and patient died 20 hours postoperatively.
8	62	F.	4/4/34	Rheumatic heart disease, mitral stenosis, aortic insufficiency, auricular fibrillation; ascites, edema of legs.	Bedridden dyspneic, orthopneic cardiac with history of 13 periods of hospitalization during past 7 years. Mitral congestive failure in 1927 and since then unable to carry on any form of activity.	+ 1	−29	−19	140/95	Moderate improvement.	The dyspnea and orthopnea were markedly relieved. This elderly cardiac has been enabled to regain a considerable amount of normal activity after being cardiac invalid for 7 years.
12	54	M.	5/19/34	Arteriolosclerotic heart disease; essential hypertension; auricular fibrillation, congestive failure.	Congestive failure since 1932. Paroxysmal nocturnal dyspnea. One kidney had been removed 8 years previously because of stones. Edema of legs.	+25			190/130	Immediate postoperative fatality.	Cerebral hemorrhage just at end of operation.
13	53	F.	8/29/34	Rheumatic heart disease; mitral stenosis; essential hypertension; sinus arrhythmia; congestive failure.	Marked dyspnea for past 3 years and orthopnea. Persistent ankle edema for past 2 years.	+ 4	−25	−11	180/120	Markedly improved.	Completely free of congestive failure three and one-half months after operation developed a peripheral neuritis.
15	49	M.	8/30/34	Luetic heart disease; essential hypertension; aortic insufficiency; auricular fibrillation.	Dyspnea and orthopnea and edema of legs since January 1934 requiring 3 admissions to hospital to become compensated. Accompanied by attack of paroxysmal nocturnal dyspnea. Right hydrothorax.	+ 2	− 9	− 7	160/95	No improvement.	Postoperative 4 episodes of decompensation, with readmission to hospital.
16	39	F.	9/18/34	Rheumatic heart disease; mitral stenosis; aortic insufficiency; auricular fibrillation.	4 admissions to hospital within 6 years for congestive failure; bedridden for one and one-half years; dyspnea and orthopnea. Edema of legs constantly for one year.	+ 2	−23	−15	130/90	Markedly improved.	At present patient is able to do all her housework, with no discomfort. Free of congestive failure.

SUMMARY OF PATIENTS WITH ANGINA PECTORIS

Case No.	Age	Sex	Date of Operation	Diagnosis	Symptoms Prior to Operation	Basal Metabolism			Blood Pressure	Results	Remarks
						Postoperative, Per Cent	Myxedema, Per Cent	On Thyroid Therapy, Per Cent			
5	59	M,	3/15/34	Arteriolosclerotic heart disease; coronary sclerosis; angina pectoris; normal sinus rhythm.	Cardiac pain on effort or rest since 1929. 1st coronary closure in Sept. 1933; 2nd coronary vessel closure in Feb. 1934. Cardiac pain unbearable; paroxysmal nocturnal dyspnea.	−14	−71	−17	134/82	Moderately improved.	Now free from cardiac pain and paroxysmal nocturnal dyspnea. Had only 1 anginal seizure due to excess of thyroid extract. As in case 13, a severe peripheral neuritis developed which prevents the patient from living normally.
6	54	M.	3/20/34	Arteriolosclerotic heart disease; angina pectoris; mutiple myocardial infarction.	Cardiac pain since 1925 on effort and exertion. Angina decubitus since 1932. Acute coronary vessel closure in 1925, recurrence in Nov. 1928; also recurrence of coronary occlusion in Dec. 1933.	− 4	−39	−10	128/80	Markedly improved.	There has been no recurrence of dyspnea, edema, palpitation or cardiac pain. Has occasional mild sensations of oppression over precordium following excessive exercise.
9	46	M.	4/17/34	Arteriolosclerotic heart disease; coronary sclerosis; angina pectoris; diabetis mellitus.	Angina decubitus and angina on effort since 1932 radiating down to left wrist. Bedridden for 3 months prior to operation and still suffered daily, 5 to 6 attacks, and cardiac pain becoming more frequent and severe.	−11	−23	− 7	138/60	Markedly improved.	No recurrence of cardiac pain since operation. During cold weather or following overexertion experiences a mild feeling of pressure. Since operation blood sugar has returned to within normal limits and apparently the renal threshold has been raised.
10	40	M.	5/12/34	Arteriolosclerotic heart disease; coronary sclerosis; angina pectoris.	Cardiac pain since 1930. Coronary thrombosis in Jan. 1932, following which his pain became more frequent and severe. Prior to operation could only walk one block slowly before pain would occur.	− 4	−46	−12	115/78	Markedly improved, until sudden death two years later.	No recurrence of pain from the time of total thyroidectomy despite the fact that patient has indulged in a great deal of exercise, strongly against our advice. Fully capable of undertaking moderate amount of work.
11	63	M.	5/15/34	Arteriolosclerotic heart disease; essential hypertension; coronary sclerosis; angina pectoris.	Cardiac pain since 1930, brought on by exertion; following coronary infarction in 1932, pain became more frequent and severe; angina decubitus and nocturnal dyspnea. Prior to operation could only walk one block. Nitroglycerine would control the pain during the attacks, requiring 100 to 150 tablets per week.	−15	−17	−13	160/110	Death within 11 weeks postoperative.	Complete freedom from pain during postoperative course until end of third week when had recurrence of mild attacks of anginal pain, relieved by nitroglycerine. In eighth week pain became more severe and signs of decompensation appeared. On eleventh week had an acute coronary thrombosis and demised immediately.
14	47	M.	8/29/34	Arteriolosclerotic heart disease; coronary sclerosis; angina pectoris.	Symptoms of cardiac pain present since January 1934, brought on by exertion and relieved by amyl nitrite. Lately attacks occurring at night and he has not been able to resume work since then.	− 2	−35	−22	110/80	Moderately improved.	Patient is working from six to eight hours a day doing rather heavy carpentry. Occasional mild attacks of pain, at irregular intervals necessitating occasional use of nitroglycerine.

portion of cases to justify such a radical surgical procedure. Such a major operation can be carried out in patients suffering from serious heart disease with an astonishing low operative mortality rate.

The successful outcome of any case depends first, on a very careful selection and thorough preoperative study of the patient, and secondly on an organization which can assure a continuous postoperative supervision and follow-up. Ambulatory patients who have been subjected to total thyroidectomy for the improvement of heart disease unquestionably require more frequent and closer observation than those not operated upon because all of these patients require the administration of dessicated thyroid extract; the determination of adequate dosage demands careful and frequently repeated clinical observations and repeated basal metabolic rate and blood cholesterol determinations.

The operative procedure of total thyroidectomy as a means of treating angina pectoris has opened paths of approach to the study of cardiac pain and the conditions surrounding its occurrence heretofore unavailable and has enlarged and will continue to add immeasurably to our knowledge of the subject.

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THE TRUSS IN RELATIONSHIP TO DIAGNOSIS AND INJECTION TREATMENT OF INGUINAL HERNIA*

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THE revival of interest on the part of the medical profession in the treatment of hernia by injection has disclosed the startling fact that there is practically complete ignorance and no authoritative information on the all important subject of trusses. As a more complete understanding of the theory and the value of the injection method has developed, it has become increasingly evident that the success or failure of this method of treatment is in a great measure dependent on the use of proper trusses for the given case. Early in their study of the injection method of treatment the authors reviewed the literature in an attempt to find a scientific exposition of the theory and mechanics of truss manufacture and fitting but could find none. The scarcity of articles based on scientific study prompted us to undertake an investigation along these lines.

The prerequisites for the treatment of a hernia by the method of injection are first, that the hernia be completely reducible, and second, that it can be held in complete reduction during the entire duration of treatment. The method of holding the contents of the sac in complete reduction involves the use of an externally fitted apparatus. If such an appliance allows the contents of the sac to distend the canal before firm fibrous tissue is deposited, the treatment fails and the method is unjustly condemned. In our early experience with this form of treatment recurrences developed in certain cases after apparent closure. These were later successfully treated and permanently closed by changing the type of truss. This change at first was more or less haphazard and all types and makes of trusses were used. It was found, however, that the response to the injection therapy varied tremendously with the different types of trusses and that certain types particularly reduced the recurrence rate markedly and aided in giving a quick firm closure.

In our early experience with the injection method, we adapted the German scrotal truss, which has a wide usage and has been sold extensively by trussmakers for the treatment of inguinal hernia. This truss consists of a semicircular spring with a triangular shaped pad and is designed to exert pressure over the inguinal canal. Examination of a patient with the truss in position shows the hernia apparently reduced. With a reducible hernia and this type of truss a successful cure of the hernia was anticipated when the proper injection technique was used. However, the fact that cures did not always result led to a more careful consideration of the truss and its relationship to the anatomy of the inguinal canal. It was immediately apparent that the construction and fitting of a truss, and its use in the injection treatment, was by no means a simple thing but that its formation and employment depended on the complex anatomy of inguinal hernias, and the little considered activity of the large muscles of the trunk and thigh which continually cause movement around the encircling band of the truss.

ANATOMICAL CONSIDERATIONS

The inguinal canal is an oblique cleft in the inguino-abdominal wall above the mesial half of the inguinal ligament, and in the adult its length varies between 4 and 5 cm. The abdominal opening or inlet of

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the canal, the internal ring, is located in the transversalis fascia about 1 cm. above the center of the inguinal ligament. The outlet, the external ring, is located in a deficiency in the aponeurosis of the external oblique which lies immediately above the crest of the pubis. The superior and deep end of the canal is lateral to the inferior and superficial end. Any increase in the intra-abdominal pressure forces the anterior and posterior walls of the canal together and aids in the support of the abdominal wall.

The varieties of inguinal hernias which may develop in this region may be classified into two principal groups: those that leave the abdomen lateral to the inferior epigastric artery, through the internal ring, and pass down the length of the inguinal canal; and those which leave the abdomen through the middle inguinal fossa, mesial to the inferior epigastric artery, and enter the inguinal canal near to the external ring. The former (Fig. 1) are known as indirect hernias, the latter (Fig. 2) as direct, and it is obvious that an externally placed truss must take these anatomical relationships into account if complete reduction of the hernia is to result. In the case of an indirect inguinal type of hernia it is easily seen that the pressure of the truss must be directed over the point of exit of the hernia, namely, the internal ring. Since the canal is 4 to 5 cm. long, pressure exerted lower along the canal, below the internal ring, allows for partial descent of the sac contents above the truss. The resultant separation of the wall of the inguinal canal and the distention of the sac, however, is masked by the truss pad and gives the erroneous impression that the hernia is completely reduced. Similarly, if the pressure is exerted over the external ring, the hernia is apparently reduced or at least prevented from dropping into the scrotum in the case of a complete hernia, but in actuality the canal remains dis-

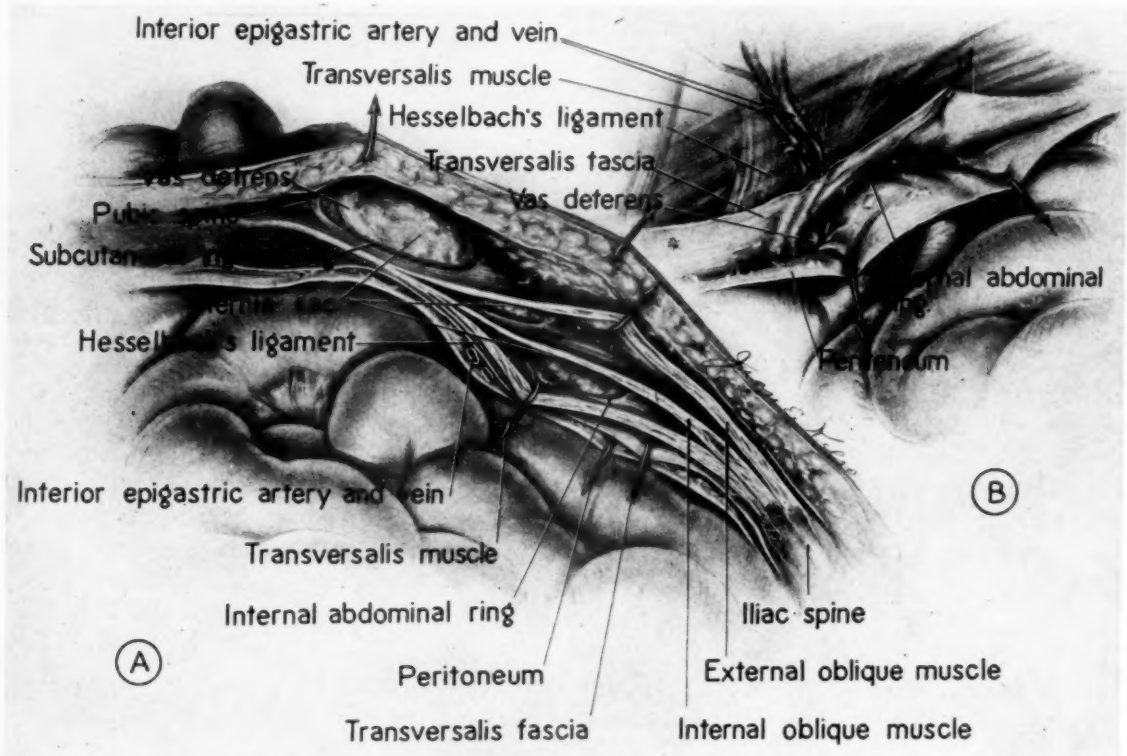


FIG. 1. Semidiagrammatic drawing illustrating indirect inguinal hernia. A, view from in front and above. Note the contents of the sac leaving the abdominal cavity through the internal ring and traveling down through the inguinal canal to emerge through the external ring. B, view from the inside of the pelvis.

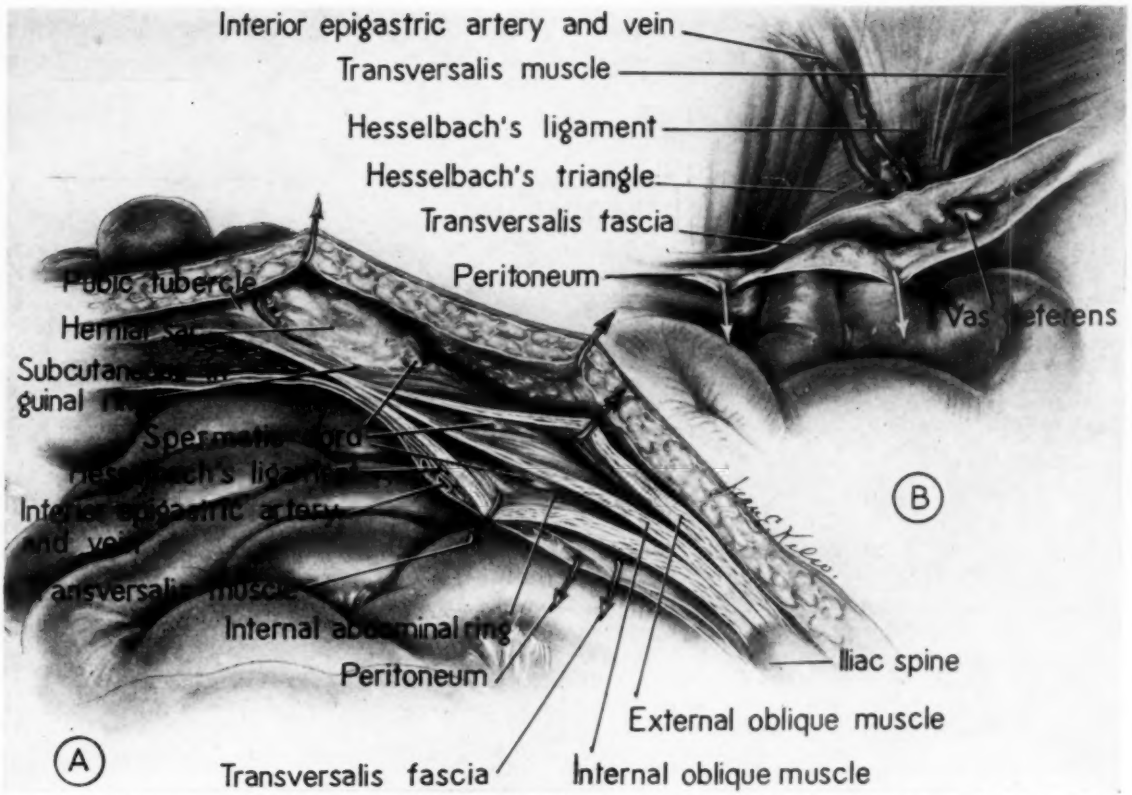


Fig. 2. Semidiagrammatic drawing illustrating direct inguinal hernia. A, view from in front and above. Note the contents of the sac leaving the abdominal cavity through Hesselbach's triangle and emerging through the external ring. B, view from the inside of the pelvis.

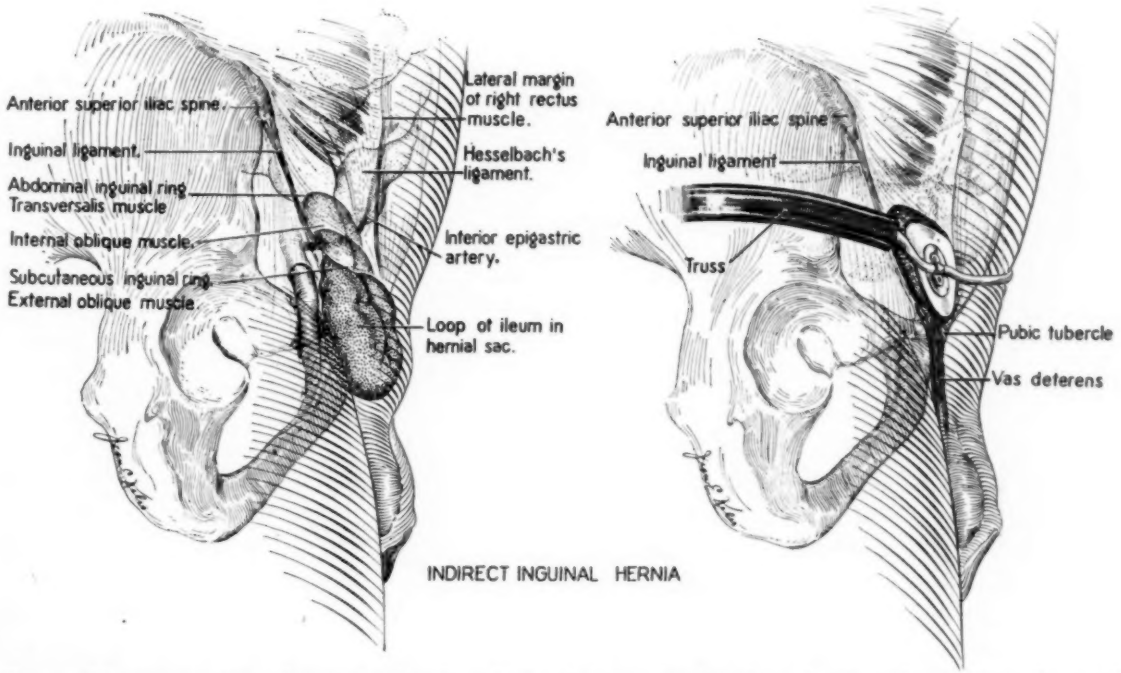


Fig. 3. Diagram to show the mechanism by which a truss maintains the reduction of an indirect inguinal hernia. Note the pressure of the truss over the internal ring.

tended with sac contents. Any truss then that is improperly placed or is so constructed that its point of maximum pressure is below the internal ring allows the rupture to occupy the upper portion of the inguinal canal and is not only anatomically unsound but useless for the injection treatment of hernia. This simple but all important fact has never been given the emphasis it deserves, for on it rests the successful outcome of treatment of indirect inguinal hernia by injections (Fig. 3).

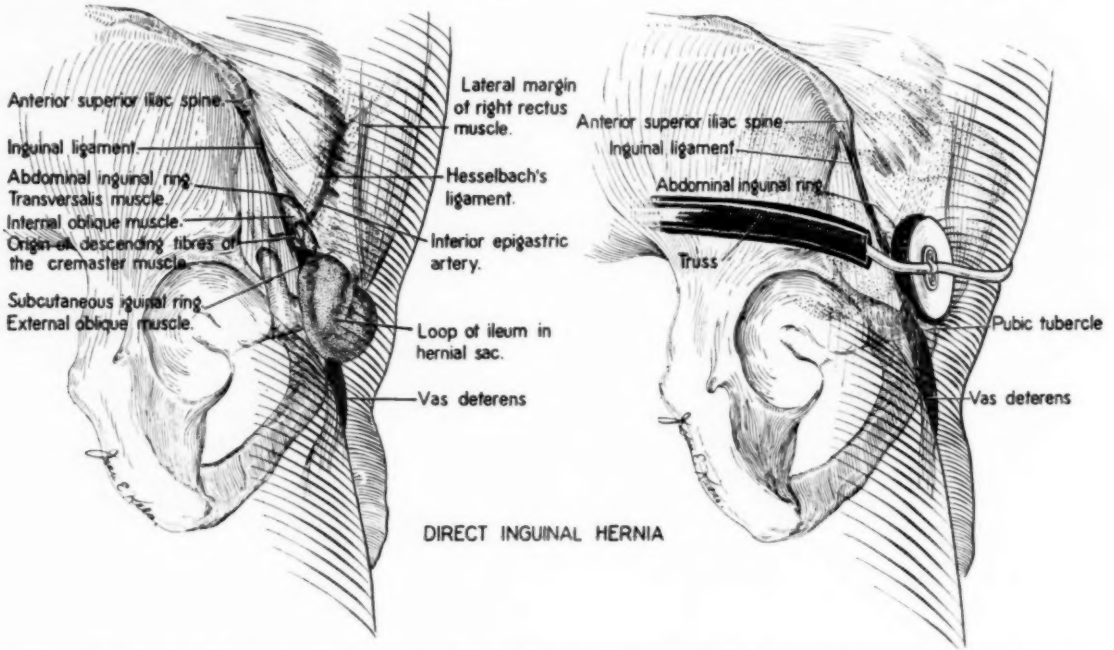


Fig. 4. Diagram to show the mechanism by which a truss maintains the reduction of a direct inguinal hernia. Note the pressure of the truss over Hesselbach's triangle.

The placement of the point of maximum pressure in a direct hernia must be over the area of deficiency in the inguinal wall through which the hernia protrudes. A truss fitted over the internal ring, in a direct hernia, will not aid in keeping the hernia in reduction. Rather the point of pressure must be over Hesselbach's triangle (Fig. 4).

The second important point in the consideration of the relationship of the truss to the anatomy of the inguinal canal concerns the direction of pressure exerted by the truss through the canal. In an indirect hernia, it is seen that the object of the truss is to hold the muscular layers in close approximation, in the region of the internal ring, in order to prevent the descent of the sac contents. It is not the purpose of the truss to hold the sac contents up in any way. An approximation of the muscular layers is not only the most effective method of holding the hernia, but it completely coincides with the normal muscular activities in that region. It is true that upward and backward pressure is necessary to reduce a hernia, but a similar pressure maintained by a truss following reduction would merely act by closing the external ring. It would allow the contents of the sac to remain within the inguinal canal, with the protruding portion of the bowel resting upon the pad. For the maximum pressure, then, the line of force must be through the canal at right angles to the truss pad. This cannot be achieved by the sort of simple encircling band used in most trusses. It is necessary to construct a fulcrum extending from the posterior band of the truss downwards over the buttock, so that the direction of pressure extends from the central portion of the pad to the lowermost portion of the fulcrum. This counterpressure posteriorly should be

somewhat lower than the center of the pad, making the line of pressure downwards and backwards (Fig. 5, B). The band to lower itself to the neutral level, the pad is forced downward away from the internal ring and the truss fails to hold the

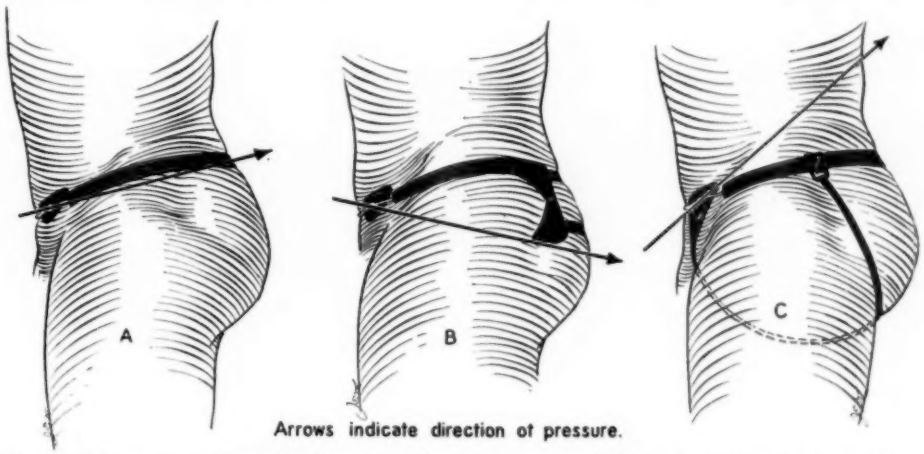


Fig. 5. Diagram to show the direction of pressure exerted through the inguinal canal by various types of trusses. A, Rigid Truss: Posterior counterpressure too high. The line of force travels upwards and reduces the efficiency of the truss. B, Semirigid Truss: Correct posterior counterpressure. Line of force at right angles through inguinal canal. C, Spring Truss: Posterior counterpressure too high. The leg strap pulls the upper portion of the pad outward, thus directing the line of force so high that the pressure over the internal ring is negligible.

correct anatomical placement of this line of force maintains reduction of the hernia with the least amount of pressure. This type of truss is likewise suitable for direct hernia.

The third anatomical consideration that must be treated concerns the relationship of the internal ring to the activity of the large muscles of the trunk and thigh. The encircling band of the truss, when placed around the lower trunk, is shifted in position by the movements of the body and leg until it occupies the area of least motion between the trunk and the thigh. This neutral point is midway between the crest of the ilium and the trochanter of the femur, above the active muscles of the thigh and below those of the abdomen. In this position the end of the encircling band rests immediately over the internal ring, and the pad which is fixed thereto must be on a direct line with the band to be anatomically correct. In most trusses the pad curves downward from the encircling band, and when the pad is placed over the internal ring the encircling band is much too high. As movement of the body causes hernia in reduction. The same situation holds true in a direct inguinal hernia. The area of weakness in Hesselbach's triangle is likewise on a line with the neutral area of muscular action, and the truss pad must be centered on the line of the encircling band.

These, then, are the important factors in the consideration of a truss for a hernia which is to be treated by the injection method: (1) its accurate placement over the internal ring, in an indirect hernia, and over Hesselbach's triangle in a direct hernia; (2) the necessity of pressure through the inguinal canal, by means of a low posterior fulcrum at right angles to the truss pad; and (3) the necessity of having the truss pad on a line with the encircling band of the truss.

Dangers if the Anatomical Considerations Are Neglected. The importance of these factors cannot be overemphasized, and their importance is best realized when consideration is given to the dangers and complications which may occur when they are neglected.

1. When the pad is placed away from the internal ring:

In this situation the bowel is constantly filling the upper portion of the canal and resting on the pad. This completely nullifies the purpose of the injections, since the constant distention of the sac causes separation of the walls of the inguinal canal. The newly formed fibrous tissue is broken down and the hernia fails to close. Even when only the very uppermost portion of the canal is left open, and the hernia seems cured following the injection treatment, that small opening at the internal ring acts as a wedge which finally results in a recurrence, due not to the fault of the treatment but rather to an incorrect truss. A truss placed too low as just described is likewise dangerous, as the bowel may easily work its way around the pad and become strangulated.

2. When the line of force of the pad is not at right angles to the canal:

A truss so constructed as to give the improper line of force through the inguinal canal fails to give close approximation of the walls of the canal, and allows partial descent of the contents of the sac. This is accompanied by the dangers mentioned. The higher the posterior portion of the truss as it encircles the body, the higher is the line of pressure and the less efficient the truss (Fig. 5). With this type of truss very much more pressure is necessary to maintain reduction of the hernia than with the proper truss. Attempts to use such a truss make the application of extremely great pressure necessary, and excoriation of the skin of the inguinal region and back are the result. Such an area makes continuation of the injection treatment impossible.

3. When the truss pad is not on a line with the encircling band of the truss:

This assumes grave importance when the results of the use of this type of truss are considered. With the pad placed lower than the encircling band, it is seen from the above mentioned anatomical considerations that the muscles of the trunk and thigh will inevitably move the encircling band down from its too high position. This immediately moves the pad away from the inguinal canal, and allows for descent of the sac contents, which by no means is the only danger. The pad itself is displaced over the pubic bone in which place it not only fails to aid in any way in retaining reduction of the hernia, but causes actual harm by compressing the spermatic cord between the pad and the bone. Considerable pain and swelling of the cord result, and in many cases atrophy of the testicle follows. Atrophy of the testicles has been noted, prior to the start of the injections, in our series, in 9.6 per cent of 300 patients with hernias. These patients have worn trusses for many years and the testicular atrophies present are undoubtedly due to this defect in the trusses which were worn by these patients.

TYPES OF TRUSSES

With these considerations in mind, the various types of trusses may be analyzed, and an evaluation made as to their anatomical and mechanical soundness, and as to their applicability to the injection treatment.

1. *Semirigid Truss.* This type of truss consists of a solid piece of phosphor-bronze covered with cowhide which encircles the hip at the neutral area of muscular activity. This bar has little spring but is so accurately fitted that it allows for no distention of the sac by its contents. Posteriorly there is a right angled projection of the bar, which extends downwards over the buttock, and gives pressure at right angles through the canal. The pad of the truss is made of either sponge rubber or factis. It is shaped to cover the canal and is attached to the end of the bar on a line with the encircling band. The correct position of the truss is maintained with the greatest comfort to the patient and with the least amount of harness. In either direct or indirect hernias, the muscles are firmly held in contact, thus insuring retention of the hernia. The truss is fastened and unfastened easily during treatment. The only

disadvantage of this truss is that it must be fitted by someone with experience and who has a knowledge of inguinal anatomy.

2. *Rigid Trusses.* Rigid trusses are of the frame type, and consist of a solid hoop of steel which surrounds the body, and

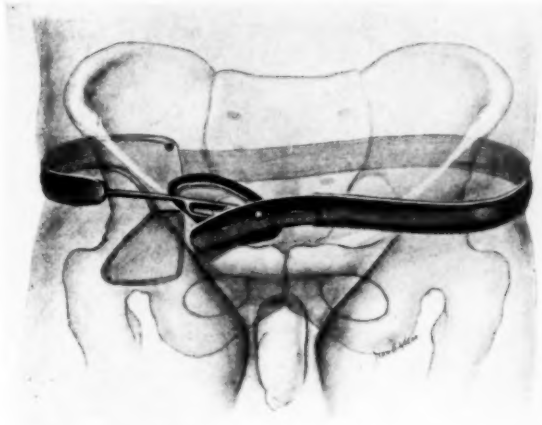


Fig. 6. Unilateral Semirigid Truss with single strap, front view. Note: (1) The correct placement of the encircling band at the area of least movement about the hips, halfway between the crest of the ilium and the trochanter of the femur. (2) The correct relationship between the pad and the encircling band. (3) The beveled sponge rubber anatomically correct pad.

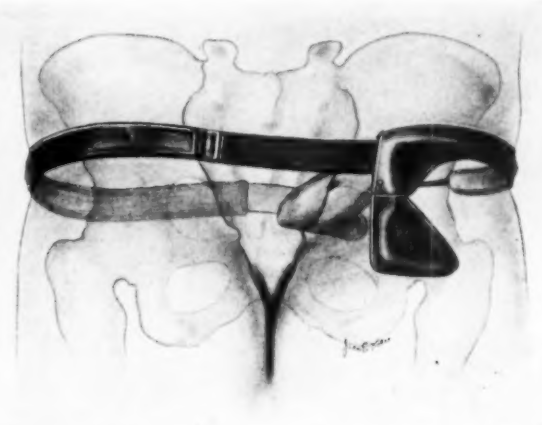


Fig. 7. Unilateral Semirigid Truss with single strap, back view. Note: (1) The posterior fulcrum giving the proper line of force through the canal. (2) The placement of the posterior fulcrum to the sacrum. (3) The beveled pad.

This type of truss may be procured in two forms, both of which are excellent and suitable for the injection treatment of hernia. The first, the semirigid truss with single strap, (Figs. 6, 7, 8, 9) is the easier to handle, and gives most comfort to the patient; but the second, (Figs. 10, 11, 12, 13) the semirigid truss with double strap is quite satisfactory.

terminates within two inches of the spine posteriorly on either side. There may be circular pads attached to the posterior ends of the hoop on the back, upon which the counterpressure is taken, or there may be instead a flat oblong disc which broadens the band at this point, and distributes the pressure over a greater surface. The truss pads are fitted in front and solidly fixed

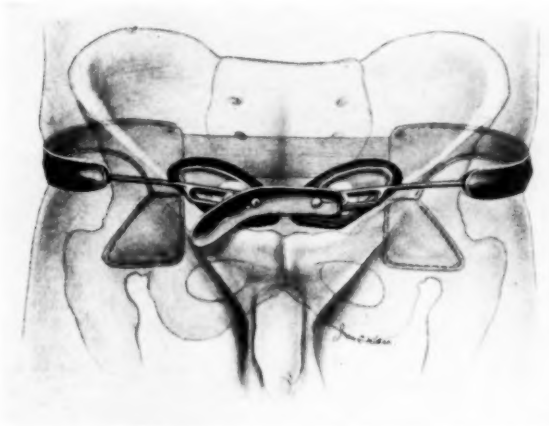


Fig. 8. Bilateral Semirigid Truss with single strap, front view.

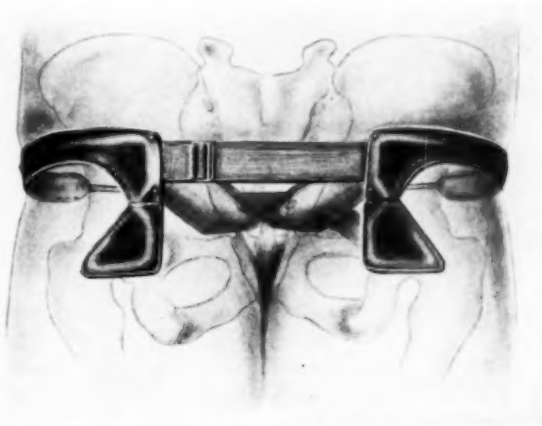


Fig. 9. Bilateral Semirigid Truss with single strap, back view.

to the bar. This type of truss does not depend on compression or spring action for its action. It merely acts as a resisting framework about the pelvis, with the pad making firm pressure over the inguinal canal while the wearer is in the upright position. Any strain merely causes the abdominal wall to be thrown forward, and it is met firmly and restrained by the pad which is attached to the pelvic frame. On lying down the frame does not follow the receding surface of the abdominal wall. This truss can be constructed in an unsatisfactory fashion when its action is not understood, by making the frame of a heavy spring. As a matter of fact, great compression can be eliminated in this type of truss. It is essential that the sides of the frame and the pad should be on the same line else as the frame takes its position over the quiet muscular area, the pad will then be forced too low.

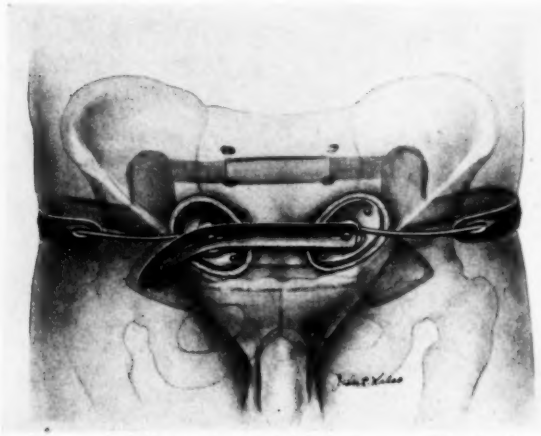


FIG. 10. Bilateral Semirigid Truss with double strap, front view. Note the oval shaped pads which are satisfactory but somewhat less efficient than the beveled sponge rubber pads.

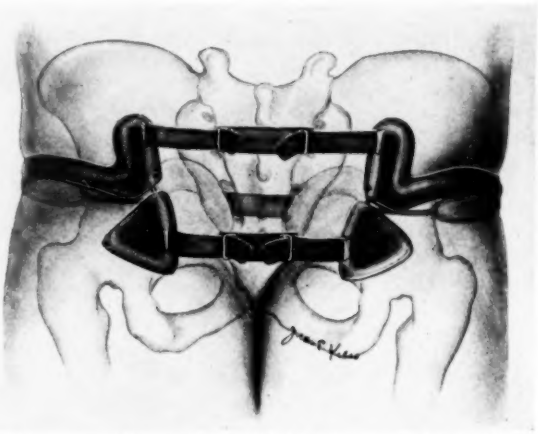


FIG. 11. Bilateral Semirigid Truss with double strap, back view. Note the two straps. The correct anatomical relationships are maintained.

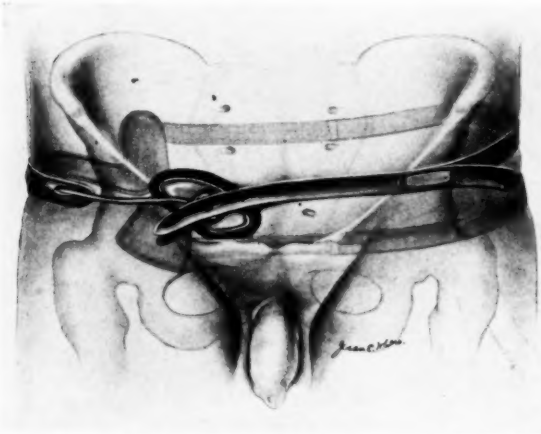


FIG. 12. Unilateral Semirigid Truss with double strap, front view. The diagram shows a beveled sponge rubber pad.

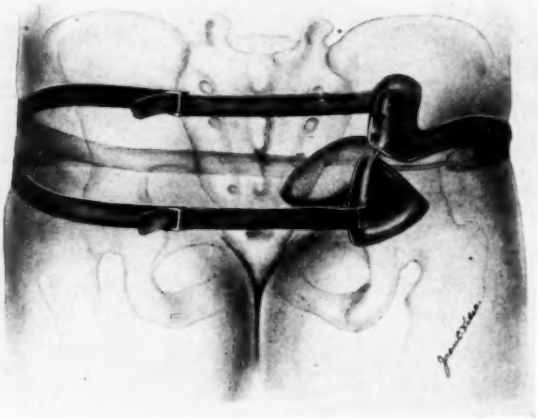


FIG. 13. Unilateral Semirigid Truss with double strap, back view.

The frame truss has the advantage of carrying either one or two pads, but it is always best with two. The one over the side which is not ruptured may be very thin. A person with a rupture on one side, is apt to develop another on the other side; a possibility more likely to happen when a single truss is worn than when none

is used, since the pressure of the truss over the hernia throws the intra-abdominal pressure toward the other side. In the case of a double hernia, the solid front frame is desirable since there can be no change in the relative position of the pads, either from the stretching of a front strap, as in other forms of double truss, or through an error in adjustment.

Any increase in weight of the patient, and consequent change of size, is better taken care of by the posterior adjustment than by an adjustment in front. A person may gain or lose several inches in size without any relative change in the position of the two inguinal canals. Further advantages of this type of truss are, that it passes around the pelvis at the most immovable part, and that the pads are on a line with the frames. Surrounding both hips gives the truss stability, and it retains the hernias with almost the minimum of pressure. Its principal disadvantage is that the posterior counterpressure is too high (Fig. 5, A) and for this reason, on many people the truss will not stay in position; it is awkward to handle during injection; and with the frame extending around the body as it does, there is a tendency for the truss to become displaced while sleeping (Fig. 14).

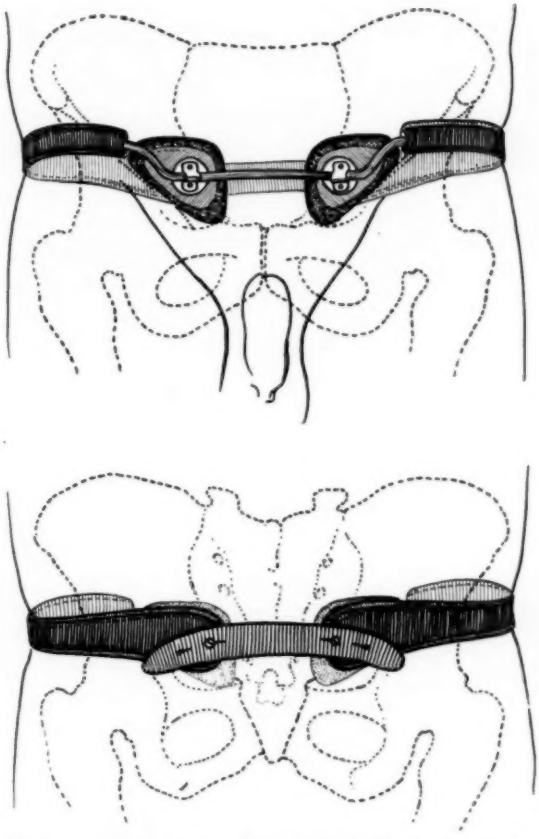


Fig. 14. The Frame Truss, simple frame type. See text for description.

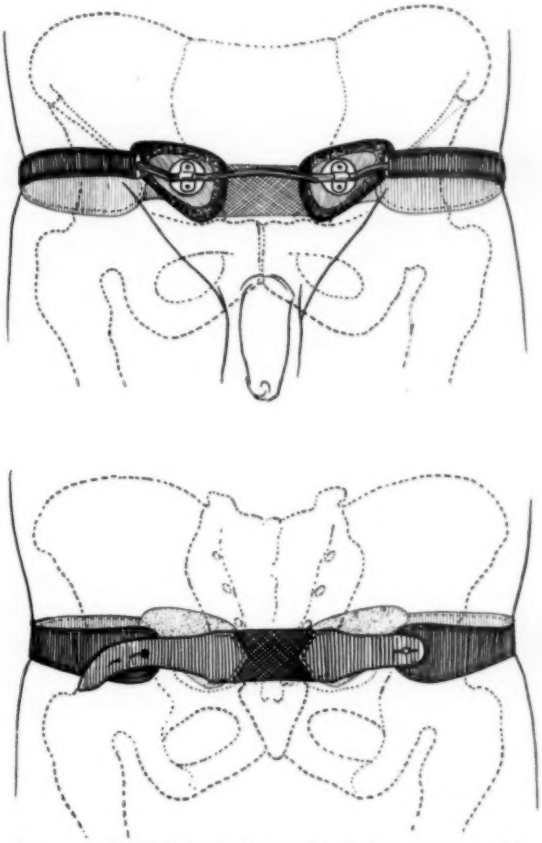


Fig. 15. The Frame Truss, short frame type. Note the shortened encircling band.

In an effort to obviate these disadvantages several modifications of this type of truss have been made. In the first type (Fig. 15), the frame terminates about four inches from the spine on either side, instead of the usual two inches, and there is less displacement when the patient lies down. The second type (Fig. 16), the frame truss with bilateral curved low counterpressure and a single strap, directs the pressure through the canal at more nearly the proper angle. The third type, the frame truss with bilateral curved low counter-

pressure and double strap (Figs. 17 and 18), is extremely powerful and probably the most efficient truss made. It will hold

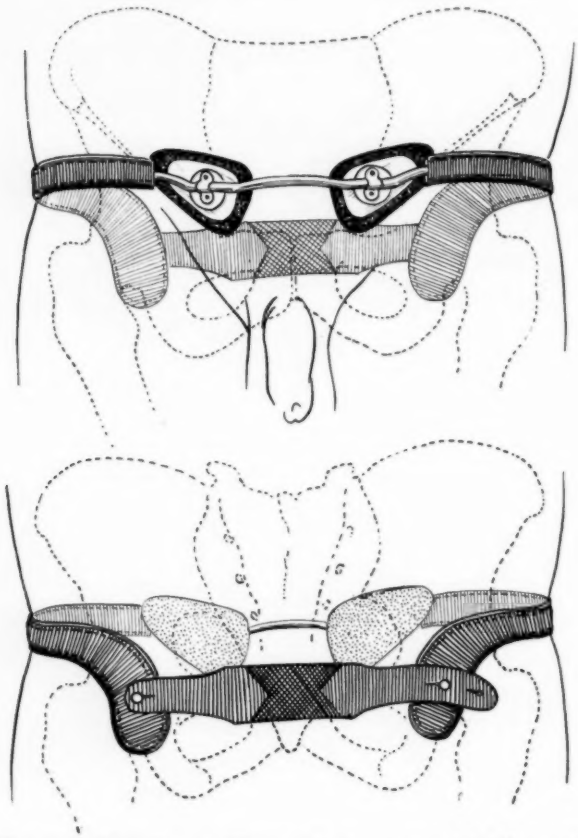


Fig. 16. The Frame Truss, single strap with bilateral low fulcrum. Note the bilateral curved posterior fulcrum and single strap.

ruptures impossible to hold with any other type. The bilateral posterior fulcrum, held by two straps posteriorly, prevents any abdominal strain from displacing the truss. The disadvantages of this type of truss are (1) that it requires special skill in fitting; and (2) that it is difficult to handle while giving injections. While all of these trusses are good, the simple frame truss and the shortened frame truss, are somewhat less efficient than the trusses in the semirigid group. The latter two, those with low counterpressure, however, are fully as satisfactory as the semirigid trusses, but have the disadvantage of being awkward to handle while injections are being given.

3. *Spring Trusses.* Spring trusses are made of a solid steel spring which extends from the inguinal region around to the back, and is held in position by a leather strap. To it is attached a triangular shaped pad which covers the inguinal region. The truss retains the hernia by the compression of the spring. There are a number of variations of the spring type of truss, but with the possible exception of the English or rat-tail variety, they are unsuitable for the injection treatment of hernia. The principal types are known as the German (Fig. 19), French (Fig. 20), Scrotal (Fig. 21) and Chase (Fig. 22) trusses, and the criticisms which may be given for one, may be applied to all. The spring which extends to the back, on the same side as the pad, is too short to give the compression necessary to hold the hernia in reduction. The pads of this type of truss arch downward over the inguinal canal and are not on a line with the spring. When the pad is placed low over the pubic bone it allows the contents of the sac to descend to the external ring and while it temporarily prevents the hernial contents from entering the scrotum, it eventually produces a much larger hernia than was present originally. The worst feature of this truss is that, even if the pad is placed properly over the inguinal canal, it will in a short time drop down over the pubic bone, as the spring descends to the neutral point between the muscles of the thigh and abdomen.

The principal difference between the French and German types is that the French are much lighter, and usually have some decoration of fancy stitching upon the leather of the outer portion of the pad. The so-called Scrotal truss is even heavier than the German type, and the pad is made much larger in a vain attempt to remedy the defects inherent in this variety. The Chase truss consists of a spring of the French type, to which an iron neck curving downwards and holding a polished hard or soft pad is attached in front. The same defects are present in this truss also. With the spring type of truss the inguinal canal is seldom closed. In an effort to increase the pressure of the pad, an understrap is ap-

plied, extending from the pad between the legs to the strap behind. While this increases the pressure over the lower portion of the pad, it shifts the line of force of the pressure even higher upwards, and opens the upper portion of the canal (Fig. 5, c). In our experience this type of truss has been particularly unsuitable for the injection treatment of hernia.

The English or rat-tail type of truss (Fig. 23), while better than the other types in this group, is much inferior to the rigid or semirigid types. In this truss the encircling spring extends around the back to the

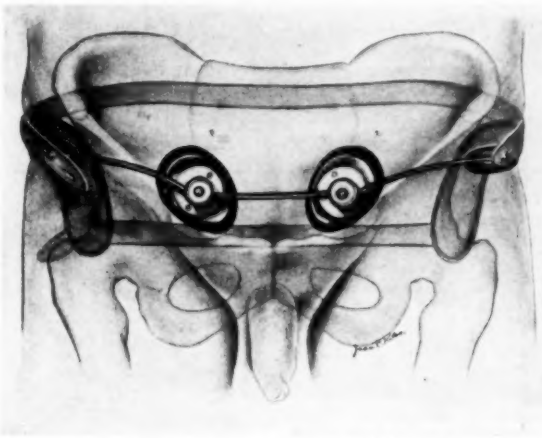


Fig. 17. The Frame Truss with bilateral curved posterior fulcrum and double strap, front view.

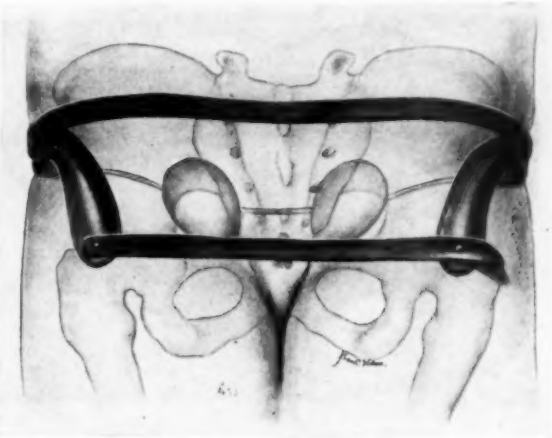
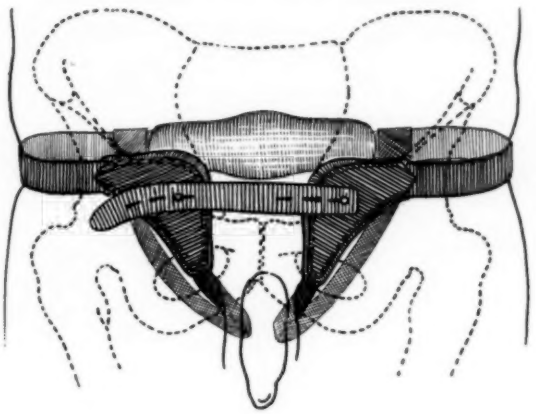
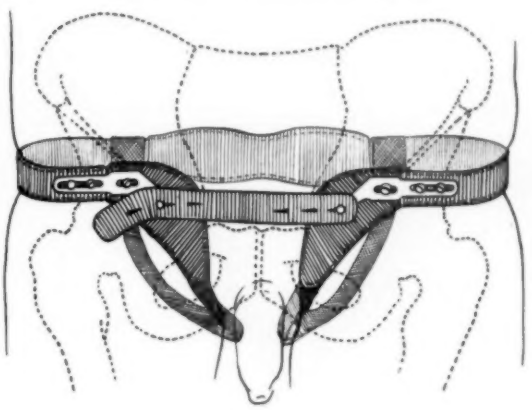


Fig. 18. The Frame Truss with bilateral curved posterior fulcrum and double strap, back view.





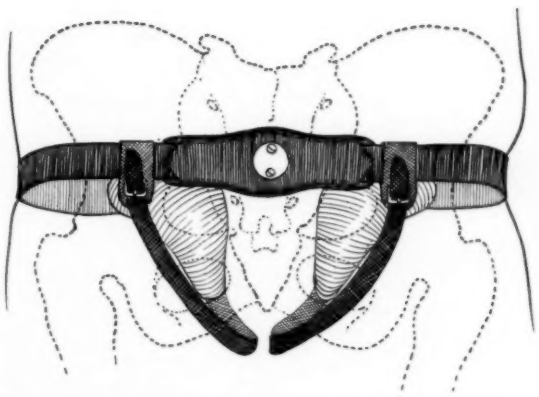


Fig. 19. Spring Truss, German type, double; front and back views.

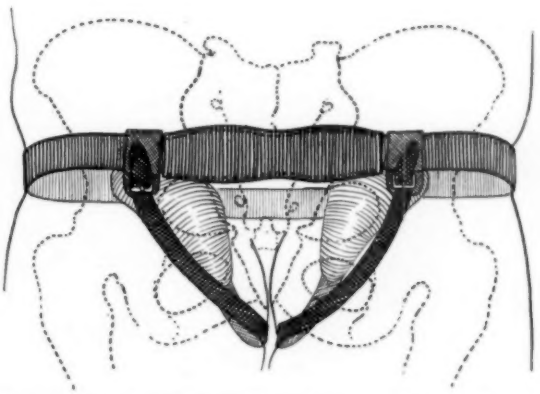


Fig. 20. Spring Truss, French type, double; front and back views.

opposite hip, giving strong pressure over the inguinal canal, and the pad is on a line with the spring. An understrap is used to increase the pressure. The principal disadvantage is that the counterpressure is much too high, since there is no posterior fulcrum.

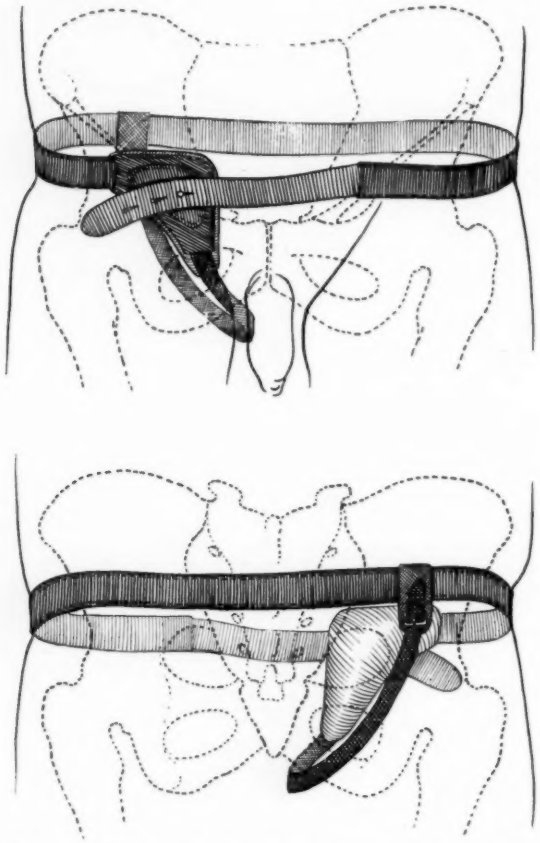


Fig. 21. Spring Truss, Scrotal type, single; front and back views.

4. *Elastic Trusses.* The elastic truss, so called because it is made of heavy elastic web, consists of a strong pelvic belt to which is attached a good sized pad, held down by a perineal strap (Fig. 24). The perineal strap, as it buttons to the lower portion of the pad, turns the lower end of the pad under, so as to give an upward as well as a backward pressure.

The elastic truss is the most frequently used truss in this country because it requires no fitting; anyone with a hernia can apply one with little trouble. Usually if worn for any length of time, they are instrumental in producing an increase of the size of the hernia. This is due to the fact that the pad is drawn down against the pubic bone by the perineal strap. This leaves the upper part of the canal unprotected and consequently occupied by part of the hernia. A hernia held in this fashion at the external ring is sure to increase in size. This type of truss would be more satisfactory if the pelvis were entirely round but since the transverse diameter of the pelvis is one-third larger than the anteroposterior diameter, this type of truss is thoroughly unscientific.

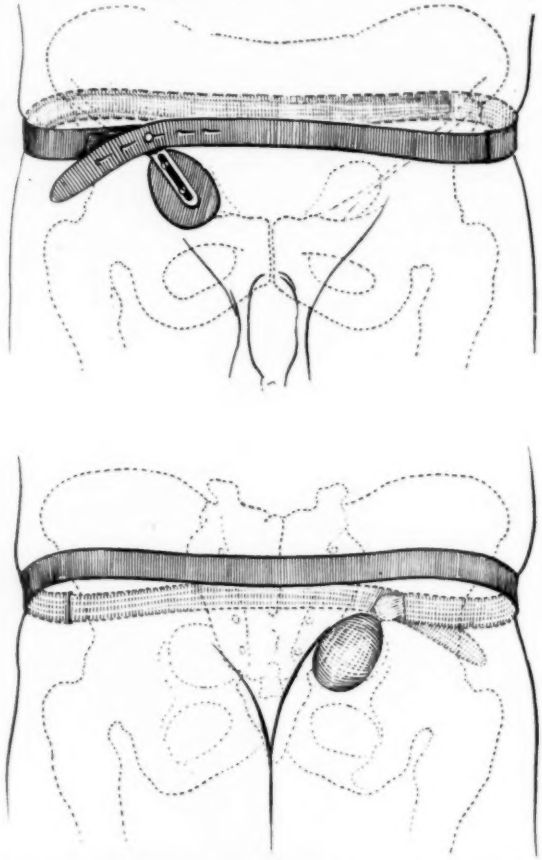


Fig. 22. Spring Truss, Chase type, single; front and back views.

A flexible band drawn tightly around the hips produces far more pressure over each hip than over the inguinal region, where the pressure is most necessary. A band placed in this position will not remain in its position without the perineal strap. This type of belt fails to place the pressure over the internal ring where it is most needed, but rather the pad presses over the pubic bone and over the external ring, allowing the upper portion of the inguinal canal to

be constantly filled with a loop of bowel or a piece of omentum. Furthermore, the pad compresses the spermatic cord against the pubic bone and may produce an atrophy of the testicle. For these reasons this type of truss must never be used in the injection treatment of hernia. Combinations of elastic and spring trusses have been advocated but their combination does not remove the disadvantages inherent in each. Any truss, whether spring or elastic, which depends on the inward pressure of an understrap for effect is unsatisfactory, since it causes an outward tilting of the upper portion of the pad. On any truss it may be occasionally advisable to place a very light understrap, merely to hold the truss down, as the patient moves in bed or otherwise grasps and moves the truss. The two leg strap functions must not be confused.

To recapitulate, then, for purposes of hernial reduction, in the injection treatment of hernia, the trusses of the semirigid group are most preferable. For many patients trusses of the frame group without low counterpressure may be used, but generally speaking they are somewhat less satisfactory than the semirigid type. Frame trusses with low counterpressure are satisfactory and for severe hernias are the truss of choice. Spring trusses should, as a rule, never be used since they fail to fulfill the function for which they were made. The English type of truss may occasionally prove to be satisfactory. Elastic trusses are entirely unsatisfactory and must never be considered. (See Table 1 for summary.)

A word must be said about the pads which are attached to the encircling band. These are made of various substances; hard rubber, factis, felt, wood and leather, but the best pad in our experience has been that made of sponge rubber. They are of various shapes; oval, round, triangular and elongated, but the most satisfactory appears to be an elongated oval pad with beveled

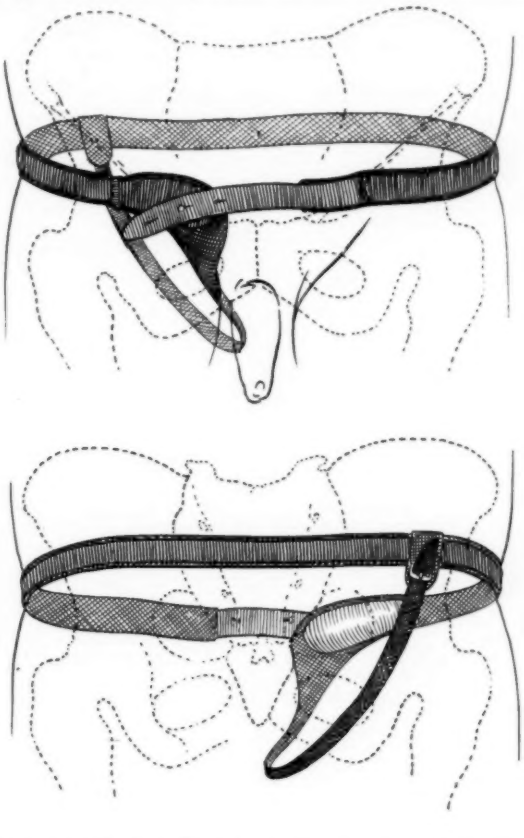


Fig. 23. Spring Truss, English or rat-tail type; front and back views.

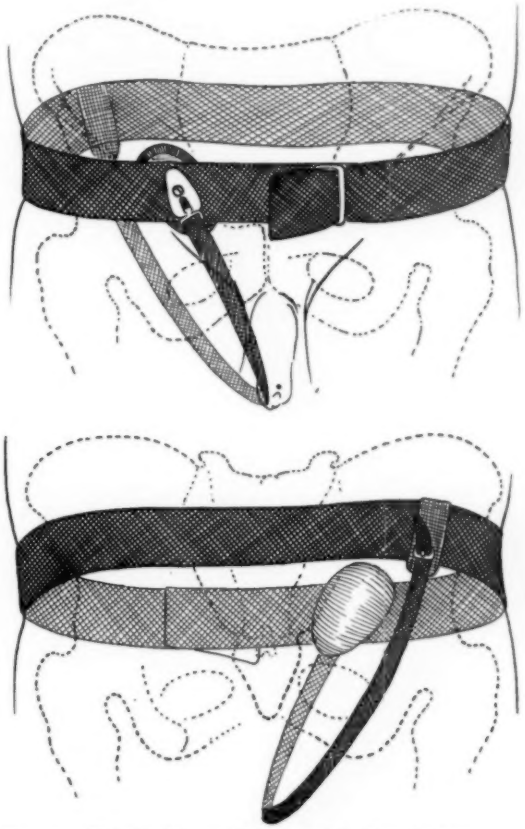


Fig. 24. Elastic Truss. See text for description.

TABLE I

SUMMARY OF TYPES OF TRUSSES, WITH AN OUTLINE OF THEIR ADVANTAGES, DISADVANTAGES AND SUITABILITY FOR THE INJECTION TREATMENT

Type of Truss	Variety of Truss	Advantages	Disadvantages	Suitability for the Injection Treatment
Semirigid	Single strap (Figs. 6, 7, 8, 9)	1. The hernia is well held in reduction. 2. Correct counterpressure. 3. Correct relationship of pad to encircling band. 4. Minimum of harness. 5. Easily fastened and unfastened during injections. 6. Can be slept in easily. 7. Can be accurately adjusted for both direct and indirect types of hernias.	1. An accurate knowledge of anatomy of the inguinal region is essential for fitting.	Adaptable for practically all hernias. Satisfactory for the injection treatment.
	Double strap (Figs. 10, 11, 12, 13)	1. The hernia is well held in reduction. 2. Correct counterpressure. 3. Correct relationship of pad to encircling band. 4. Easily fastened and unfastened during injections. 5. Can be slept in easily. 6. Can be accurately adjusted for both direct and indirect types of hernias.	1. An accurate knowledge of anatomy of the inguinal region is essential for fitting.	Adaptable for practically all hernias. Satisfactory for the injection treatment.
Rigid	Simple frame (Fig. 14)	1. No great compression necessary for hernial reduction. 2. Correct relationship of pad to encircling band. 3. Posterior adjustments of straps and solid front frame prevents displacement of pads.	1. Posterior counterpressure too high. 2. Awkward to handle during injections. 3. Easily becomes displaced during sleep. 4. Requires skill in fitting.	Adaptable for small hernias in certain individuals. Satisfactory for the injection treatment only in selected cases.
	Short frame (Fig. 15)	1. No great compression necessary for hernial reduction. 2. Correct relationship of pad to encircling band. 3. Posterior adjustments of straps and solid front frame prevents displacement of pads. 4. Can be slept in easily.	1. Posterior counterpressure too high. 2. Awkward to handle during injections. 3. Requires skill in fitting.	Adaptable for small hernias in certain individuals. Satisfactory for the injection treatment only in selected cases.
	Single strap with bilateral low counter pressure. (Fig. 16)	1. No great compression necessary for hernial reduction. 2. Correct relationship of pad to encircling band. 3. Posterior adjustments of straps and solid front frame prevents displacement of pads. 4. Can be slept in easily. 5. Correct posterior counter pressure.	1. Requires skill in fitting. 2. Awkward to handle during injections.	Adaptable for practically all hernias. Satisfactory for the injection treatment.
	Double strap with bilateral low counter pressure. (Figs. 17, 18)	1. No great compression necessary for hernial reduction but an extremely great compression can be maintained for difficult hernias. 2. Correct relationship of pad to encircling band. 3. Posterior adjustments of straps and solid front frame prevents displacement of pads. 4. Can be slept in easily. 5. Correct posterior counter-pressure. 6. Double posterior strap prevents slipping of the truss. 7. Can retain practically all hernias.	1. Awkward to handle during injection. 2. Requires especial skill in fitting. 3. Cumbersome for the patient to wear.	Adaptable for practically all hernias but much too powerful a truss to be used on small hernias. Suitable for the injection treatment.

TABLE I (*Continued*)

Type of Truss	Variety of Truss	Advantages	Disadvantages	Suitability for the Injection Treatment
Spring	Scrotal truss (Fig. 21)	1. Can be fitted easily.	1. The truss spring is too short to give the necessary compression. 2. Incorrect relationship between pad and encircling band. 3. Posterior counterpressure is too high. 4. The truss is heavy and uncomfortable for the patient. 5. Can cause dangerous complications by giving pressure over the cord and pubic bone. 6. Fails to completely hold hernias in reduction.	Entirely unsatisfactory for the injection treatment.
	German truss (Fig. 19)	1. Can be fitted easily.	Same as scrotal truss	Entirely unsatisfactory for the injection treatment.
	French truss (Fig. 20)	1. Can be fitted easily.	Same as scrotal truss	Entirely unsatisfactory for the injection treatment.
	Chase truss (Fig. 22)	1. Can be fitted easily.	Same as scrotal truss	Entirely unsatisfactory for the injection treatment.
	English truss (Fig. 23)	1. Can be fitted easily. 2. The spring is of sufficient length to give the necessary compression. 3. Correct relationship of pad to encircling band.	1. Posterior counterpressure is too high. 2. Fails to hold in reduction a large majority of hernias.	Satisfactory for the injection treatment only in selected cases.
Elastic	All varieties (Fig. 24)	Requires no knowledge for fitting.	1. Greatest pressure is over hips, not over the inguinal canal. 2. Causes pressure over the spermatic cord and pubic bone. 3. Posterior counterpressure too high. 4. Anatomically unsound. Cannot be fitted accurately over the area of weakness. 5. Fails to retain practically all hernias. 6. Prolonged use results in an increase in the size of the hernia.	Should never be used in the injection treatment.

edges, anatomically fitted to the inguinal canal. For indirect hernias, the thickest portion of the pad should be over the internal ring, whereas in direct hernias, the thickest portion should be over Hesselbach's triangle. It is advisable to cover the pad with a layer of thin flannel to absorb moisture.

TRUSS FITTING AND THE DIFFERENTIAL DIAGNOSIS OF HERNIA

With the proper truss selected, the next consideration is its application to the given case. It is not the purpose of this article to give detailed instruction in the mechanics of truss fitting but rather to point out the broad principles on which truss fitting is based. The average surgeon has neither the time nor inclination to handle the details of truss fitting personally, and these are best left to the trussmaker, who should work and cooperate with the surgeon. However, the responsibility for the proper placement of the truss remains with the operator, and it is upon the accurate diagnosis of the type of hernia present that this placement is made.

The question of the differential diagnosis of types of inguinal hernia is of utmost importance in the injection treatment of hernia for two reasons: (1) as it concerns the placement of the truss, and (2) as it concerns the placement of the injections. Neither too much time nor too much care can be given to this phase of the method.

In the examination of a patient for hernia, the first consideration is to determine the presence of a hernia. The differentiation between hernia and hydrocele, varicocele, femoral hernia, sarcoma of the testicle, and the other numerous tumor masses, which may occur in the inguinal region and scrotum, must be made. Following the determination of an inguinal hernia, the second consideration is the definite diagnosis of the type of hernia; either indirect, direct or a combination of both. Thirdly, the question of total or partial reducibility of the hernia must be decided. It is with these latter two that we are here concerned.

The differential diagnosis between an indirect and direct inguinal hernia can be definitely made by means of the following maneuvers. The patient is first examined in the upright position, and if a truss is being worn, this should of course be removed. It seems unnecessary to mention that the underclothing should likewise be removed, but it is surprising to find surgeons attempting the diagnosis of hernia with underclothing only partially removed, and constantly obscuring the view of the examiner. With the patient, then, in the upright position, a mass is usually seen presenting itself in the groin. An oblong mass extending from the internal ring, down the canal, is usually an indirect hernia, whereas an oval mass more toward the midline, away from the canal and cord, is more apt to be a direct hernia. Pressure made over the mass will indicate its reducibility in the standing position. It is not advisable during this maneuver to place the finger of the examining hand through the scrotum into the canal, since nothing is gained by this procedure, and considerable harm to the muscles and fascial layers may be done. The testicles and cords should be palpated, and accurate measurements taken for purposes of future reference.

The patient is then placed on a table in partial Trendelenburg position, and the contents of the sac allowed to drop back into the abdominal cavity. The index finger of the examining hand is then placed within the inguinal canal by invaginating the skin of the scrotum with the palm of the hand down. The subsequent findings in an indirect inguinal hernia are as follows: As the examining finger passes through the external ring, the area of muscle weakness is found to extend laterally toward the internal ring. Superiorly may be found the frayed fibers of the external oblique muscle. Medially the thick well formed conjoined tendon is easily palpable as it is attached to the pubic bone. However, the pubic bone cannot be felt except as covered by muscular tissue. Laterally there is a considerably thinning of the inferior crus of the external ring, and posteriorly the firm transversalis fascia is palpable. On coughing the contents of the sac strike the superior and lateral portion of the examining finger.

In a direct hernia, the examining finger, upon passing through the external ring, immediately drops through the muscular and fascial weakness in Hesselbach's triangle. Superiorally may be felt the edge of the external oblique muscle. Laterally are felt the firm fibers of the external and internal oblique muscles as they form the inguinal ligament. Medially the conjoined tendon is noted to be extremely thin and in large hernias, may be entirely absent. The pubic bone is very easily palpable and strikes the finger as an uncovered bony structure. This we have designated as the "bare area" of the pubic spine pathognomic of direct inguinal hernia. Inferiorally the posterior wall is felt to be extremely weak, and the examining finger drops down easily into the fascial weakness of Hesselbach's triangle. On coughing, the impulse of the sac contents strike the examining finger at the inferior and medial margins of the finger.

By means of these findings, and those made with the patient in the upright position, a tentative differentiation can usually be made. As a further check, firm pressure is made over the internal ring, and with this pressure constantly maintained, the patient is allowed to get up from the table.

If on examination the hernia is still reduced, the examining fingers are removed and the hernia, which will be of the indirect inguinal type, allowed to descend. On the other hand, if the hernia is present in the standing position following this maneuver, with pressure still maintained over the internal ring, the hernia must be of the direct type, since it has descended despite pressure over the internal ring. This maneuver may be repeated with pressure exerted over Hesselbach's triangle as an additional check on a possible direct hernia. In a certain percentage of cases the hernia will be of the saddle-bag variety, and there will be both a direct and indirect element. By means of the described maneuvers, this fact can be ascertained.

In addition to these procedures there is one more aid in the differential diagnosis which is not commonly known. In the male the inguinal ligament varies in length from 9 to 19 cm. Careful check-up on 300 cases has shown that when a hernia is present in a patient whose inguinal ligament measures less than 15 cm. it is always of the indirect type; and conversely when the inguinal ligament measures more than 15 cm. the hernia is always of the direct type. It has likewise been noted that the length of the penis varies inversely with the length of the inguinal ligament. In other words, in those patients with relatively short inguinal ligaments, the external genitalia are relatively large, and will measure upwards of 7 cm., and in those patients with long inguinal ligaments the penis will measure less than 7 cm. It follows that the indirect type of inguinal hernia will always occur in patients with relatively large genitalia, and that the direct type will occur in those with smaller genitalia. The reasons for these findings are obscure, but a logical explanation would be that a long inguinal ligament would require a great deal of fascia for its formation, leaving less available for Hesselbach's triangle and the external genitalia, and would thus predispose to a direct inguinal hernia. On the other hand, a short inguinal ligament would leave a great deal of fascia available for Hesselbach's triangle and the external genitalia, and the only possible type of hernia which could develop would be an indirect hernia, due to a congenital defect in the development of the descending testicle.

It may be mentioned at this point that these diagnostic maneuvers will reveal a much higher percentage of direct inguinal hernias than the incidence which is given in most textbooks. These claim an incidence of 6 to 8 per cent of direct hernias, whereas in our series 31 per cent have been of the direct type. This includes cases of simple direct, direct hernias associated with indirect hernias of the saddle-bag type, and recurrent postoperative direct hernias.

With the accurate diagnosis of the type of hernia made, its reducibility remains to be determined. The question of reducibility is especially important since non-reducible hernias cannot be treated by the injection method. The reducibility of the hernia can be best made out with the patient lying in the Trendelenburg position. Careful palpation along the inguinal canal, or in the region of Hesselbach's triangle, will reveal the presence of any irreducible sac contents. These must be differentiated from the thickened walls of a large hernial sac, which may be entirely empty, from thickened structures of the cord, and from a tag of properitoneal fat which may be attached to the outside of the neck of the sac. In a number of cases, a small tag of omentum caught within the sac may show very little of a demonstrable mass, but merely give an obliteration of some of the details of muscle and fascia position which would ordinarily be found. With these things in mind, however, the reducibility of a hernia can usually be decided definitely. In those cases in which there is any question, or in which there is any difficulty in affecting reduction, it is not advisable to so manipulate the hernial sac contents as to cause damage to tissue. It must be rea-

lized that these cases are not amenable to cure by the injection method, but must be treated by the accepted surgical procedures.

APPLICATION OF TRUSS TO PATIENT

Assuming that by means of these diagnostic procedures an accurate diagnosis has been made and with the consideration of the proper type of truss in mind, the actual fitting of a truss to the given case may proceed. Following the first application of the truss by the trussmaker it is advisable that the patient report to the surgeon for check-up as to its position and effectiveness. It will be found that in most cases, several or more adjustments of the truss will be necessary during the first week or two, to insure complete retention of the hernia at all times.

For the purposes of treatment the truss must be worn day and night for a period of six to eight weeks, and before treatment is started it is imperative that the patient be able to keep the truss on constantly. In some patients, particularly children and adults of blond complexion, it will be impossible to keep a truss on continuously at first since the tenderness of the skin predisposes to blisters and excoriation under the truss. In these patients it will be necessary to begin the truss wearing for a few hours each day, gradually increasing the time until it is being worn continuously. Under no circumstances should the injection treatment be begun until the patient has been able to wear the truss day and night for one week, without protrusion of the contents of the hernial sac.

It is advisable during the period of truss adjustment to bathe the area underneath the truss pad daily with soap and warm water, and to massage the area gently with alcohol therafter. The application of the following dusting powder is helpful.

℞

Ammoniated mercury (powder)		3
Zinc oxide	8	
Zinc carbonate	8	
Boric acid	1	
Powdered talc q.s.	30	

M. Sig.: Apply locally

If there is considerable redness and swelling of the skin, application of hot or cold compresses for a period of thirty minutes daily are soothing, and will relieve the inflammation. Once the truss is worn continuously the question of bathing becomes important to the patient. The search has been long for a true waterproof truss but up to the present time no satisfactory waterproof truss has been placed on the market. Various efforts to take care of this difficulty have resulted in different types of trusses; the first is that made of steel, of the semi-frame type, with a complete covering of rubber. The truss is sturdily made and extremely satisfactory as far as holding the hernia is concerned; however, the continuous wearing of a rubber truss tends to irritate the skin by causing a considerable perspiration between the skin and the truss which cannot be absorbed. The patients complain of burning and itching, especially underneath the strap, which encircles the body. A second attempt at waterproof trusses has been made by saturating the leather covered truss in paraffin. In cooler climates this truss will remain waterproof for up to two years; however, in warm climates the heat tends to melt the paraffin and the truss remains satisfactory only for about two to three months. A satisfactory arrangement is for the patient to construct a rubber apron which may be fitted over the truss and worn as a shower is taken. However, most patients will have to be content with sponge baths.

CONCLUSION AND SUMMARY

With an understanding of the considerations outlined, the injection treatment can be an effective method for the cure of inguinal hernia. Accuracy in the diagnosis of the various types of inguinal hernia, care in the selection of the proper kinds of trusses, and cooperation between the surgeon, trussmaker and patient in the fitting of the truss, will insure the maximum success with this therapeutic procedure.

1. The importance of trusses in the injection treatment of hernia, and the general

ignorance and misinformation of the profession in this regard, make scientific study of this problem imperative.

2. The anatomy of inguinal hernias must be understood in its relationship to the application of trusses.

3. The important factors in consideration of a truss for hernia are first, its accurate placement over the internal ring, in an indirect hernia, and over Hesselbach's triangle in a direct hernia; second, the necessity of pressure through the inguinal canal at right angles to the pad; and third, the need for alinement of the truss pad and the encircling band.

4. The failure to adhere to these essential principles, which are based on the anatomical structure of the inguinal region, results in danger to the patient and failure of the injection treatment.

5. The various types of trusses are analyzed and their advantages and disadvantages evaluated.

6. The importance of differential diagnosis between direct and indirect types of inguinal hernias, in the application of a truss, is stressed. The diagnostic importance of the "bare area" on the pubic spine in direct hernias is emphasized. Newer conceptions in the differential diagnosis show definite relationships between the length of the inguinal ligament and the occurrence of direct and indirect types of hernia.

7. With an understanding of these factors the application of the truss to a given case is discussed.

8. A detailed observance of the principles outlined will insure satisfactory results in the injection treatment of hernia.

PATHOGENIC microbes are the one constant causative agent in all cases of puerperal fever. There is no such case as aseptic thrombophlebitis, or aseptic febrile conditions in the puerperium. Any organism that can produce a morbid state in a surgical wound may become the agent of puerperal infection. Puerperal infection is surgical wound infection.

Puerperal Infection by James Robert Goodall, M.D.

FOREIGN BODIES IN TRACHEOBRONCHIAL TREE

OBSERVATIONS AND REVIEW OF 30 CONSECUTIVE CASES

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FOREIGN bodies in the air passages occur with relative frequency, their incidence, of course, cannot be tabulated, but it is sufficient to state that these preventable accidents may happen at any age.

Beginning with the newborn who may aspirate meconium or regurgitated food, to the adult who accidentally chokes on his food, the aspiration of foreign bodies into the tracheobronchial tree are in the main, avoidable accidents. The foreign body, in itself, is not dangerous, except when completely obstructing the larynx or the trachea, thereby causing obstructive asphyxia. Here, of course, immediate removal of the foreign body is a life-saving measure. Most foreign bodies that lodge in the tracheobronchial tree produce secondary bronchopulmonary disease. It is these pulmonary complications and their sequels that may end disastrously.

The foreign bodies are of three classes; animal, vegetal and mineral matter. Since the advent of bronchoscopy and roentgenography, there is no reasonable excuse for any foreign body remaining lodged in the lung longer than it takes to determine its location and preparation for its extraction. In recent years, this matter has been called to the attention of the profession and the layman with sufficient frequency to make one suspicious, at least as a possibility, in all obscure pulmonary diseases. One might almost make it an axiom, that in a previously healthy person, who gives a history of sudden paroxysms of coughing, dypsnea, cyanosis, asthmatic breathing, and in late cases, hemoptysis, fever, and chest pains, that cannot be explained on the basis of a definite disease entity, foreign body should be suspected. This is likewise true in those cases of atypical suppurative pneumonias, particularly in children.

In all lung abscesses, unless a definite etiological factor is found, suspect possible foreign body, and rule it out. It should be remembered that the *x*-ray will not always identify a foreign body, unless it is radio-opaque. Metallic objects and animal matter, such as bones are usually easily defined. Occasionally bones, unless of sufficient density, may not show a defined shadow, because as is frequently the case, the shadow may be obscured by a dense infiltration of lung tissue. The bronchoscope is the instrument of choice to eliminate conclusively the possibility of foreign body or to establish its presence.

There is practically no contraindication to bronchoscopy when it is to be used for extraction of foreign bodies.

The *x*-ray is a most valuable adjunct and should be used before bronchoscopy is undertaken, to locate the probable site of the foreign body so that the bronchoscopic procedure is shortened. When a non-opaque body is the offending agent, a roentgenogram will show, in many instances, a classical picture which results from obstructive emphysema or atelectasis. The simple use of the stethoscope will frequently help to establish the diagnosis, particularly if there are signs of an obstructive bronchial lesion.

Almost all foreign bodies in the tracheobronchial tree can be removed endoscopi-

cally, and, it may be said, with complete safety to the patient. The prospects of full recovery are excellent, provided that the foreign body is removed within a reasonable time after aspiration. In other words, the sooner the foreign body is removed from the air passages, the better the prognosis for recovery.

We are reporting 30 cases of foreign bodies aspirated into the tracheobronchial tree, observed during the past five years on the Laryngological Service at the Mt. Sinai Hospital. Of the total, 13 were bones, 8 metallic and 9 vegetal bodies.

The vegetal group gave prompt signs and symptoms of bronchial inflammation. This prompt reaction is due to the irritation by the fixed oils present in vegetable matter, and early draws attention to the probable diagnosis. In this group, the longest period of the offending body present in the lung was fourteen days before removal.

Of the remaining 21 cases, the metallic and bone group, the diagnosis was not established in 9 instances for a period ranging from nine weeks to ten years.

The foreign bodies were removed endoscopically in all 30 cases. Complication resulted only in those instances where the diagnosis of a foreign body was not made within nine weeks.

On analysis, the age group is as follows:

Age in Years	No. Cases
1 or less	5
2 to 10	8
21 to 30	3
31 to 40	4
41 to 50	2
51 to 60	6
61 to 70	2

The foreign bodies are as follows:

Bony substances: 7 meat and 4 chicken bones, and 2 incisor teeth.

Metallic substances: 1 straight pin, 1 paper clip, 1 screw, 2 gold tooth crowns, 1 gold inlay, 1 safety pin, and 1 upholsterer's tack.

Vegetal bodies: 3 peanut kernels, 1 indian nut kernel, 1 pistachio nut shell, 1 pecan nut shell, 1 watermelon seed, 1 pumpkin seed, and 1 squash seed.

ABSTRACTS OF CASES

Case 1. Adult, aged twenty-nine years; meat bone in right lower lobe bronchus present one day. *X*-ray picture negative.

Case II. Child, aged three years; watermelon seed present five days. *X*-ray film negative.

Case III. Adult, aged thirty-eight years; chicken bone in right lower lobe bronchus present eleven weeks. Choked on eating chicken. Five days later developed fever, grippe, unresolved pneumonia. *X*-ray plate showed infiltration of the right lower lobe. On bronchoscopy a flat bone 6 by 12 mm. was completely occluding the right lower lobe bronchus; foul pus was present. Lipiodol bronchogram showed bronchiectasis. He was rebronchoscoped because of a flare up after upper respiratory infection. His recovery was complete.

Case IV. Adult, aged twenty-eight years; one-half a squash seed present ten days giving symptoms of paroxysmal cough; followed by recovery.

Case V. Adult, aged fifty-nine years; bone in the left lower lobe bronchus present seven months, causing recurrent episodes of cough, fever, foul sputum and hemoptysis. A clinical diagnosis of carcinoma of the lung was made. *X*-ray films showed infiltration of the left lower lobe with a foreign body. Lipiodol injection showed a bronchiectasis with atelectasis. He was symptom free after two months.

Case VI. Child, aged eight years; paper clip in the right main bronchus present four days. *X*-ray revealed a partial atelectasis of the right middle and lower lobe. Recovered.

Case VII. Adult, aged fifty-eight years; bone in right main bronchus present two years, causing a cough for two years, chest pain, hemoptysis and loss of weight. *X*-ray showed atelectasis of the right lower lobe. On bronchoscopy a bone was removed from the right lower lobe bronchus, following which the lung became aerated. He was symptom free, although lipiodol bronchogram showed a cylindrical dilatation of the right lower lobe bronchi.

Case VIII. Adult, aged forty-eight years; gold tooth crown in the right lower lobe bronchus present twenty-five days. He aspirated the tooth crown and began to cough

seven days later. *X*-ray revealed a foreign body. The crown was removed; pus was found in all the branches of the right lower lobe bronchus. Recovered.

Case ix. Child, aged two and one-half years; metal screw in the right lower lobe present two hours. *X*-ray showed a foreign body. Patient recovered.

Case x. Adult, aged thirty-six years; meat bone (pig's knuckle) in the right lower lobe present nine weeks giving him pain in the right chest, fever and cough; diagnosed as pneumonia, right lower lobe; *x*-ray pictures showed consolidation of the right lower lobe with a dense shadow within the consolidated area. On bronchoscopy a large amount of non-foul pus was present in the right lower lobe. The bone was removed. He developed pleural infection which proved to be an anaerobic infection of pleura for which a thoracotomy was done. He died from this wound infection and sepsis.

Case xi. Adult, aged sixty-eight years; gold inlay in right main bronchus present two hours. *X*-ray plate showed the foreign body.

Case xii. Adult, aged thirty-seven years; upholsterer's tack in the left lower lobe bronchus present ten years. He gave a history of small hemoptyses for a few years. Nine weeks prior to hospitalization, he developed bronchopneumonia of the left lower lobe complicated by emphysema. Operation was done for multilocular putrid lung abscess. Following the operation the patient remembered aspirating the tack. Bronchoscopy revealed stenosis of left lower lobe bronchus, and the tack removed. The patient died from a metastatic brain abscess.

Case xiii. Adult, aged fifty-two years; chicken bone in right lower lobe present one year, causing paroxymal cough for one year, associated with wheezing. He was more comfortable when sleeping on his right side. The foreign body was removed on the second bronchoscopy. There was bleeding from the granulations, and bronchoscopy was repeated because of persistent bronchiectasis.

Case xiv. Adult, aged thirty-three years; incisor tooth in left lower lobe present one and one-half years, and was previously diagnosed as pulmonary tuberculosis. The tooth removed followed by recovery.

Case xv. Adult, aged twenty-three years; chicken bone in the right lower lobe present twenty months. *X*-ray pictures showed consolidation of the left lower lobe with bronchiectasis. He had rheumatic heart disease, foul sputum, hemoptysis four months after aspiration of the foreign body, fever and pain in chest. He died of pneumonia.

Case xvi. Adult, aged fifty-seven years; chicken bone in the right main bronchus present one week. *X*-ray showed a foreign body.

Case xvii. Child, aged twenty months; peanut kernel in the right main bronchus present twenty hours producing symptoms of dyspnea and cyanosis. *X*-ray picture showed increased aeration of the right lung with widening of the intercostal spaces. A diagnosis of ball-valve foreign body was made. On bronchoscopy the peanut was removed.

Case xviii. Child, aged six years; a bone in the right lower lobe present one year. *X*-ray picture showed atelectasis of the right lower lobe. Bronchoscopy revealed purulent infection with exuberant granulations of the right lower lobe. The bone was removed but bronchiectasis persisted.

Case xix. Adult, aged fifty-two years, bone in right lower lobe bronchus present one year. *X*-ray film showed infiltration of the right lower lobe with a pleural thickening. Bronchoscopy revealed bleeding granulations with pus in the right lower lobe. The bone was removed on second bronchoscopy. Lipiodol injection showed saccular bronchial dilatation of the right lower lobe.

Case xx. Child, aged ten years; pumpkin seed in the right lower lobe present three days. Bronchopneumonia developed but the child recovered.

Case xxi. Child, aged sixteen months; open safety pin with the point up in the trachea present two hours. *X*-ray picture showed the pin. Following extraction the child developed an upper respiratory infection but recovered.

Case xxii. Child, aged nine years; pistachio nut shell transfixed in anterior-posterior subglottic region present ten days. Symptoms presented an inspiratory and expiratory stridor. There was a low grade fever and some swelling of the anterior tracheal wall. The shell was extracted and was followed by an uneventful recovery.

Case xxiii. Adult, aged sixty-two years; meat bone present one day, with symptoms of

cough, and a marked subcutaneous hemorrhage of the face due to violent coughing. Patient at first refused medical care, then returned and consented to bronchoscopy when the bone was removed and followed by recovery.

Case xxiv. Child, aged seven and one-half years; indian nut in the right main bronchus present two weeks with symptoms of chills and fever. *X*-ray pictures showed a pneumonia of the right lower lobe. Bronchoscopy revealed a stenosis of the right main bronchus. The pneumonia cleared up after the extraction of the foreign body.

Case xxv. Child, aged two years; straight pin in right lower lobe present eight days. *X*-ray showed the pin head down in the right lower lobe. Eleven hours after aspiration, the first attempt at another hospital failed to remove the pin. Eight days later, with combined bronchoscopy and fluoroscopy, the pin was removed and the patient recovered.

Case xxvi. Child, aged eight months; pecan nut shell lodged in trachea, present twenty-four hours.

Case xxvii. Child, aged two and one-half years; peanut kernel in the right main bronchus present five days. *X*-ray picture showed an obstructive emphysema of the right chest.

Case xxviii. Adult, aged fifty years; incisor tooth in the right lower lobe present ten days. While intoxicated he fell down stairs and lost a tooth and was followed by symptoms of incessant coughing. Bronchoscopy revealed a narrowing of the right lower lobe bronchus. The patient recovered.

Case xxix. Adult, aged twenty-eight years; gold tooth crown in trachea above bifurcation present twenty-four hours, producing symptoms of persistent cough for twenty-four hours. On bronchoscopy the artificial gold tooth with a small piece of vulcanite casing attached was removed. The patient recovered.

Case xxx. Child, aged two and one-half years; peanut kernel in the right main bronchus present twenty-four hours, causing symptoms of persistent cough. *X*-ray showed slight emphysema of the right lung. The patient recovered.

DEATHS

There were 3 deaths in this series of 30 cases. A brief summary of each case follows.

Case xv. The patient had rheumatic heart disease; a bone in the bronchus for twenty months complicated by bronchiectasis with a dilatation of pulmonary vessels. His death was accidental, due to instrumentation.

Case x. Foreign body, bone in bronchus for nine weeks. The patient developed suppurative bronchiectasis with a lung abscess, and death was due to pleural infection.

Case xii. Upholsterer's tack in left lower lobe bronchus for ten years, complicated by putrid lung abscess and emphysema. Operation done and multilocular putrid lung abscess found. Death was due to a metastatic brain abscess.

SUMMARY

A series of 30 cases of foreign bodies in the tracheobronchial tree are reviewed. Pulmonary suppuration does result from prolonged bronchial obstruction. Fatalities occurred in 3 cases. Immediate complications were not observed. Tracheotomy was not necessary in this group.

INSERTION OF SMITH-PETERSEN NAIL FOR INTRACAPSULAR FRACTURES OF NECK OF FEMUR*

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SINCE its introduction by Smith-Petersen[1] in 1931, the three-flanged nail has been widely recognized as a most efficient method of fixing two fragments of cancellous bone together and its application to intracapsular fractures of the femur has been practiced in surgical centers in various parts of the world.

The chief objection to the procedure is that its introduction under direct vision by means of a complete exposure of the hip is a formidable procedure, especially when applied to senile and debilitated patients. Consequently, numerous methods of avoiding this large operation have been suggested and practiced. For instance, O'Meara[2] introduces the nail blindly and has done so successfully through a small lateral incision. However, this method presupposes considerable accuracy on the part of the surgeon and for that reason has not been generally adopted. Wescott,[3] Bunnell[4] and others have used mathematical projection apparatus for directing the nail. These methods also are difficult to apply and have not been generally adopted. Johansson,[5] King,[6] Carrell[7] and others have had their nails drilled through the center or head and have first inserted one or more Kirschner wires and then, after checking the position of the wires with the radiograph, have threaded the nail on the wire which has been found to be in a satisfactory position and driven it into the head of the femur and have then withdrawn the wire. This method is probably the best method yet devised. The chief objections are that it is difficult to obtain the Smith-Petersen nails made of a solid piece of stainless steel which have a canal drilled through the center for the passage of the wire, and that several instances have been reported in which the wire has become bent or kinked or has been forced into the pelvis while the nail was being driven home. In such instances difficulty has been encountered in removing the wire.

I wish to report a method which I have used which requires less special apparatus and which appears to be one which can be used without difficulty by the average orthopedic surgeon. It differs from the blind nailing or from the nailing with projection apparatus in that a drill is first passed through the neck and into the head of the femur and the position of this drill is checked by roentgenograms. Then, using the drill as a guide, the drill is pulled out and the nail is driven home. This method is applicable to all intracapsular fractures of the neck of the femur in which the patient is believed to be in a condition to stand a moderate surgical procedure. I think that it should be done as soon after the accident as practicable. However, if the patient is in shock he should be put to bed with the leg in traction (about ten pounds) with the knee and hip slightly flexed and slightly abducted until the condition has improved sufficiently to justify proceeding with the reduction and nailing. This may take a few days or, of course, the patient may not improve sufficiently to warrant interference. The method is especially valuable in cardiac patients who have difficulty in remaining recumbent as they may be propped up in bed immediately after the operation.

The Smith-Petersen nail is used in fractures which are believed to be impacted because the method enables these patients to be gotten up soon after the operation. It is to be remembered, how-

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ever, that when the nail is driven into the head the impaction is broken up and the head and neck are separated and the fragments must be re-impacted.

Fig. 1. Fracture through the neck of the femur before and after nailing. Note that the fracture is slightly over-reduced in that the head tends to sit on top of the neck in the valgus position.

TECHNIQUE OF PROCEDURE

Anesthesia. I have used avertin or morphine and local anesthesia. The patient is given a relatively small dose of avertin (65 to 70 mgm. per kilo.) or ¼ grain of morphine. About 10 c.c., of 1 per cent novocain is then injected into the hip joint. The injection is made by inserting the needle vertically to the surface at a point about 1 inch below Poupart's ligament and 1 inch lateral to the femoral artery. The needle can be felt to slip through the distended capsule and some sanguinous fluid can be aspirated when the point of the needle is in the joint.

Reduction. The patient is then placed upon a fracture table and the sound limb is fixed to the traction apparatus in full abduction without undue tension and with just enough traction to hold the patient against the perineal post. The hip is then reduced by the Leadbetter method as follows: While an assistant fixes the pelvis by pressing downward upon the anterior superior spines, the surgeon flexes the hip and knee of the fractured leg to slightly beyond a right angle and, while maintaining it in a position of slight external rotation and slight adduction with moderate traction upward in the long axis of the femur, has a second assistant pull outward and downward on the upper portion of the thigh, thus tending to unlock the fragments and to stretch the capsule around them. The surgeon maintains the axial traction and circumducts the hip outward and downward, at the same time internally rotating it, thus bringing it downward to a position level with the table in moderate abduction and internally rotated to about 30 degrees. Leadbetter's heel-palm test is then applied; that is, if the reduction has been successful it will be possible to maintain the limb in a position of internal rotation by simply resting the heel of the abducted leg on the surgeon's palm. If the reduction has not been successful, as soon as the foot is released the extremity will roll outward into external rotation.

If this occurs the reduction is repeated until the Leadbetter test is positive. The foot on the fractured side is then fixed

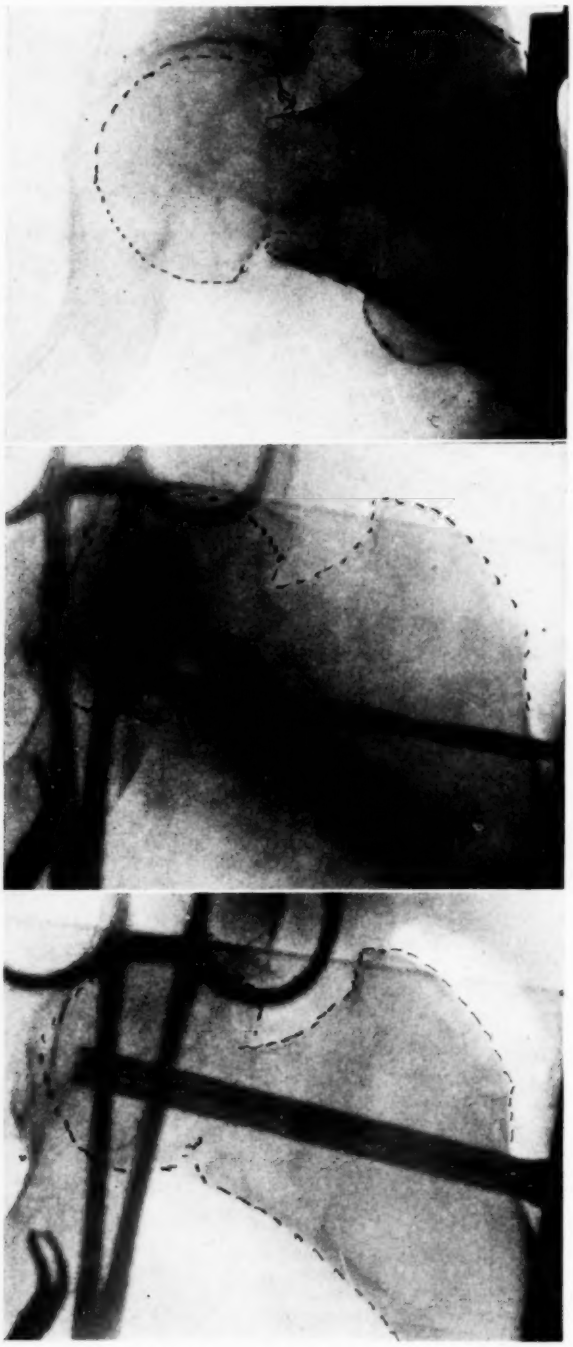

FIG. 2. Same hip. Above, showing reduction; middle, showing drill in position, the drill being too near the lower border of the head; lower, showing nail driven at a slightly different angle to approach the center of the head.

to the traction apparatus of the table in a position of about 45 degrees of internal rotation and moderate abduction, the abduction being maintained without undue tension and just enough traction being applied to hold the pelvis firmly against the perineal post.

First X-ray Picture. At this point anteroposterior and lateral *x*-ray pictures are taken. We have used the curved cassette for the lateral *x*-rays. However, any method which gives a satisfactory lateral *x*-ray may be used, but I think it important that the patient should not be moved again until the nail has been driven home.

Preparation of Patient and Local Anesthesia. While the *x*-ray films are being developed the surgeon scrubs up and the operative field is prepared by an assistant and the patient is draped. The skin and subcutaneous tissues down to and including the periosteum over the lateral border of the femur from just above the trochanter downward a distance of about 8″ are anesthetized with novocain (1 per cent for the skin and ½ per cent for the deeper tissues and containing 3 drops adrenalin to the ounce). The first *x*-ray films are developed by the time the surgeon is ready to begin the operation. Then, if the reduction is satisfactory, the operation is begun. If not, the reduction is repeated.

Operation. An incision about 6 inches long is made over the lateral surface of the femur, the upper end being at about the tip of the trochanter and extending straight downward along the lateral border of the thigh. This incision is carried down to the bone and through it the tip of the trochanter can be felt. Then, from the *x*-ray film this distance can be roughly measured on the outer border of the femur to reach a point from which a nail or drill inserted through the outer cortex, being directed parallel to the neck of the femur, will penetrate the center of the head. This point is about ½ inch below the base of the greater trochanter. The drill is then inserted at this point parallel with the table and directed upward at an angle corresponding roughly with that of the axis of the neck of the femur. I use an ordinary

carpenter's hand drill and a 3/16 of an inch twist drill 6 inches long. I start the drill just below where I think it should be, because my tendency is to put it a little high, and give it just a little more angulation than I think is necessary, because my tendency is to put it too near a right angle with the shaft of the femur. The drill is inserted about 3 inches and is left in situ.

Second X-ray Pictures. The field is then covered with a sterile sheet and anteroposterior and lateral *x*-ray pictures are again made. It is necessary to wait until these are developed before proceeding further.

Insertion of the Nail. From the position of the drill the length of the nail desired for this particular hip is selected. It is, of course, not necessary that the drill penetrate to the cartilaginous margin of the head as due allowance can be made for any lack of penetration. Likewise, if the drill has been driven through the head into the acetabulum, as may occur, one can allow for this. If the drill is in the correct position—that is, extends down the center of the neck, preferably just below its middle—it is pulled out, and it slips out easily with the fingers, and the nail is driven home along the drill hole. If, however, it is found that the drill is too high or too low or is pointed a little too much up or down toward the head or foot of the patient, or if it is pointed forward or backward a little too much, then the nail is not driven in parallel with the drill hole, but in such a direction that it will reach the vicinity of the center of the head of the femur.

If the surgeon has difficulty in fixing in his mind the direction of the drill during the slight interval when it is pulled out of the hole and the nail is started, then he should drive a nail or insert a small drill into the femur about an inch above or an inch below the drill while the drill is in situ as a guide while the Smith-Petersen nail is being driven parallel to this guide. If it has not been found to be in the desired position, then the guide acts as a line from which the correction can be made. It should be remembered that absolute mathematical accuracy in placing the nail is not necessary. All that is necessary is to get it through the neck and firmly into the head of the femur. After the nail has been driven home the distal fragment is firmly impacted upon the head. For this the Smith-Petersen impactor is desirable, but if this is not at hand, a short length of ½ inch metal pipe or the handle of a hammer or large chisel may be used.

Fig. 3. Same hip, lateral view. Upper, showing reduction; middle, showing the drill in position, slightly more forward than desirable; lower, showing nail driven at a slightly different angle from the drill to approach the center of the head.

Third X-ray Pictures. The field is again covered with a sheet and anteroposterior and lateral *x*-rays are made with the nail driven home and the fragments impacted. While these are being developed the surgeon proceeds to close the wound, but asepsis is maintained until the final *x*-ray films have been inspected, because if the final *x*-rays are not satisfactory the wound can be opened and the nail extracted and reinserted if necessary. After the wound is closed and the dressing applied the extremity may be placed in a Thomas splint with the knee and hip slightly flexed and the hip slightly abducted or the patient may be put to bed with or without fixation of the extremity.

FIG. 4

FIG. 5

FIG. 4. Fracture through the neck of the femur six weeks after nailing. Note the slight under-reduction; that is, the head is in a slight varus position.
FIG. 5. Same hip as in Figure 4 ten months after operation.

In my first cases I left the Thomas splint on for from two to four weeks. At the end of this time the splint was removed and the patient was gradually gotten up on crutches. In more recent cases I have not immobilized the leg after the operation. At the end of a month I think it is well to let the patient begin to bear some weight upon the leg, but believe that the crutches should be continued until at least three months after the operation and that the nail should remain in for a year unless it gives trouble. If the nail does not give any trouble I do not see any necessity for removing it at all.

A word should be said in regard to the reduction. It is not my belief that an anatomical reduction is necessary or even desirable. I prefer a slight over-reduction of the fracture; that is, I would rather have the distal fragment displaced slightly downward so that the head tends to sit on the top of the neck, thus producing a slight coxa valga. This, I believe, permits more thorough impaction than does an anatomical reduction and gives a better chance of union, because it tends to lessen the shearing force at the site of the fracture. Such a reduction is illustrated in the patient shown in Figures 1 to 3 inclusive. This is not necessary, however, as shown in Figures 4 and 5. In this instance the distal fragment is displaced slightly upward; yet this patient has obtained union and apparently had a normal hip five months after the operation, walking without a limp and going up or down stairs in the normal manner.

SUMMARY

As a guide for the insertion of a Smith-Petersen nail in intracapsular fractures of the femur, the author first inserts a 3/16 of an inch twist drill. This gives the direction as well as the length of nail desired.

The technique of the operation is described in detail.

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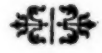

The number of deaths from abortion is only in part available from the Census Bureau. The interesting and accurate study of maternal mortality conducted by the Children's Bureau . . . comprises material in thirteen states for the year 1927, and for these same states and two others in 1928. There were 1824 deaths in these two years due to abortion, or 912 a year. Since these states comprised 26 per cent of the Birth Registration Area of the United States we have 3508 abortion deaths annually in the United States. This number must be corrected by the addition of abortion deaths reported to the coroner and classified as homicides (approximately 5 per cent); and by the fact that the area covered in the Children's Bureau survey is 36 per cent urban and 64 per cent rural compared with the general average for the United States of 42 per cent urban and 58 per cent rural. These two corrections would bring the recorded abortion deaths for the entire country to not less than 4000.

Abortion by Frederick J. Taussig, M.D.

LOCAL APPLICATION OF COD-LIVER OIL IN SKIN ULCERATIONS*

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THE therapy of wounds, ulcers and burns by the local application of preparations of high vitamin content has been developed in Europe during the last few years. Most reports to date have eminated from Germany[1] while a few have appeared in the French[2] and English[3] literature. Despite the fact that the results obtained by these workers have been encouraging, little has been written in the journals of this nation. For this reason, this series of 31 cases is being recorded. Although, a group as small as this is insufficient to establish a therapeutic agent, the results were so unencouraging, that it was deemed inadvisable to continue this study.

TECHNIQUE

All types of skin ulceration, with the exception of malignant and luetic lesions, were accepted for treatment. Other measures were obviously indicated in these two exceptions although cod-liver oil and anhydrous lanolin dressings were occasionally used in conjunction with the indicated injection or surgical therapy.

In most instances the patient was hospitalized but a small number were treated while ambulatory. The only auxiliary therapy employed in these patients was the use of Ace bandages in the ambulatory patients having ulcers secondary to varicose veins and in the healed ones after their release from the hospital.

Biopsies, cultures, radiography and other laboratory procedures were used in establishing the diagnoses. All of the patients studied in this investigation were charity cases and in none was the diet optimal. On the other hand, demonstrable clinical signs or symptoms of avitaminosis were not noted in either series. Those in the hospital received a general diet and no extra vitamins were administered orally.

The cod-liver oil was mixed with equal parts of anhydrous lanolin and a generous amount of this mixture was applied to the ulcer. These applications were renewed every second day. Ordinary gauze bandages covered with oil silk were used over the medication. The patient was advised not to use the extremity under treatment any more than was absolutely necessary. Those in the control series were treated in the same manner except that anhydrous lanolin alone was used as a local dressing.

Plain cod-liver oil was employed in several patients suffering from eczema or pyodermia. The results were disappointing in most instances although marked improvement was occasionally obtained in pyogenic infections.

It is unfortunate that no accurate method of comparison has been devised for the study of ulcers of the skin. The prognosis varies greatly with the size, duration and cause of the ulcer so that the length of time necessary to affect a cure is not an accurate measure of the healing power of any remedy. Therefore, it has been found necessary to offer a clinical impression of the results obtained rather than a definite system of grading although the latter would be preferable if practicable.

"Good" results in this study indicates complete healing of the ulcer within a "reasonable length of time," dependent on the factors mentioned which in general was three to six weeks. The fallacy of this method is clearly shown in the two series presented in this report. The results with cod-liver oil were slightly superior to those obtained with the anhydrous lanolin alone

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but the percentage of "good" results obtained in the two series does not demonstrate this difference.

RESULTS

In reviewing Table 1 which presents a comparison of the two series, one is impressed by the fact that simpler cases were treated with anhydrous lanolin alone rather than with cod-liver oil and anhydrous lanolin together. There were 22 per cent more varicose ulcers in the control series and there were 22 per cent fewer ulcers of more than one year duration. The one ulcer that had persisted for thirty-five years made the average duration greater in the second group.

A fact not recorded in Table 1 is that epithelialization proceeded more rapidly with the high vitamin preparation although healthy granulation tissue was formed equally well with anhydrous lanolin.

The basic problem of correcting the underlying etiological agents was purposely avoided in this study. This was done in order to test the actual healing power of the preparations being studied without introducing other factors. As a result, 6 of the patients treated with cod-liver oil and 2 of the control cases have already suffered recurrences.

The only complication noted during the use of anhydrous lanolin was the appearance of a new lesion in the area being treated in a patient with a trophic ulcer due to a central nervous system lesion. The complications with cod-liver oil included a dermatitis venanata that developed after two weeks of treatment, and recurred with each subsequent application of the oil. This patient also had an associated stasis eczema. An infection with Bacilli pyocyaneus occurred in another patient and did not clear with further applications of cod-liver oil.

In studying these cases, it was noted that an ulcer that recurs after being "healed" with either of these preparations, does not respond as well when treated with the same preparation a second time.

DISCUSSION

Many attempts have been made to demonstrate the mode of action of cod-

Table 1
A COMPARISON BETWEEN THE TWO SERIES

	Cod-liver Oil and Anhydrous Lanolin		Anhydrous Lanolin	
	No. Cases 21	Per Cent	No. Cases 10	Per Cent
Sex				
Male	15	71.4	6	60
Female	6	28.6	4	40
Age				
Youngest	20		35	
Oldest	73		71	
Average	53		54.8	
Diagnosis				
Varicose	8	38.1	6	60
Microaerophilic hemolytic streptococcus	2	9.5	0	
Arteriosclerosis	2	9.5	0	
Decubitus	2	9.5	1	10
Traumatic	1	4.8	1	10
Trophic	1	4.8	1	10
Thromboangiitis obliterans	1	4.8	0	
Thrombophlebitis	1	4.8	0	
Acrodermatitis chronica atrophicans	1	4.8	0	
Scleroderma	1	4.8	0	
Coccidioides	1	4.8	0	
Poorly healed fracture	0		1	10
Size of ulcer				
Largest	190 × 160 mm.		150 × 28 mm.	
Smallest	20 × 15 mm.		15 × 3 mm.	
Average	3013 sq. mm.		1291.5 sq. mm.	
Duration				
Longest	15 years		35 years	
Shortest	1 week		2 weeks	
Average	2.9 years		6 years	
Duration				
More than 1 year	13	61.9	4	40
Results				
Good	14	66.6	7	70
Fair	3	14.3	2	20
Poor	4	19.1	1	10
Ambulatory	3	14.3	2	20
Complications				
Recurrences	6	28.6	2	20
B. pyocyaneus infection	1	4.8	0	
Dermatitis venanata	1	4.8	0	
New ulcer developing under treatment	0		1	10

liver oil in the healing of ulcers. All investigators to date believe the results to be due to the action of the vitamins. Wolbach and Howe[4] pointed out that epithelial repair occurs with recovery from vitamin A deficiencies. Nordman, Bisceglie and Katzenstein (quoted by Loehr[1h]) demonstrated that vitamins stimulated growth in tissue cultures. Dietrich (also quoted by Loehr[1h]) injected vitamin D concentrates into the ears of rabbits and found that this produced epithelial cysts and proliferation.

It has long been held that vitamins are necessary to maintain the integrity and to promote the repair of the epithelial structures of the body. Santi[5] feels that peptic ulcers can be produced in rats by the use of a vitamin A-free diet.

Loehr[1h] has noted that cod-liver oil is sterile and that when streptococci, staphylococci and Bacilli coli are introduced into it they are soon destroyed. Cultures taken from ulcers under local vitamin treatment continue to show the presence of these organisms for some time. Loehr, however, postulated that they have lost their toxicity. This is an important concept as ulcers kept at rest and free from infection tend to heal. In this series, microaerophilic hemolytic streptococci were neither destroyed nor rendered non-toxic.

Macintyre[3a] in 1931 reported a cure in a chronic ulcer by the use of "artificial sunlight." Horn and Sandor[1d] and Zoltan[11] have reported encouraging results in wounds treated with local applications of vitamin A. Loehr[1g,h] has been using cod-liver oil and vaseline dressings in wounds for more than three and one-half years and is very enthusiastic about the results obtained. Schmier[6] secured good results with metuvit in ulcers of the skin. Metuvit is an ointment consisting of zinc oxide, lithium and certain animal fats subjected to quartz lamp irradiation.

There are certain advantages to be gained by employing cod-liver oil in the treatment of ulcers. Its outstanding characteristic is found in its prompt relief of pain. The wounds are kept free from most pyogenic organisms. The necrotic tissue rapidly sloughs away from the living tissue leaving a clean granulating surface. Epithelialization proceeds at a fairly rapid rate. In this inadequate series, the ulcers were at least temporarily healed in the majority of instances.

On the other hand, a number of disadvantages are also apparent. The odor is very unpleasant although the patient eventually becomes accustomed to it. The treatment is expensive as large amounts of the mixture are necessary to keep the lesions saturated. It is very difficult to remove the odor from the bed clothes and if washed with other clothes, the odor permeates the latter. Granulation tissue forms more rapidly than the epithelial tissue so that it becomes necessary to cauterize the granulations at intervals. Recurrences are apt to occur if local therapy alone is employed. The oil may increase the toxicity of anaerobic organisms by its effect on the environment and it does not destroy Bacillus pyocyaneus. A contact dermatitis may also occur in susceptible patients. It does not cure the surrounding stasis eczema nor does it relieve associated pruritus. Its superiority over anhydrous lanolin is questionable and the disadvantages probably outweigh the advantages.

The main objection is that "good" results were obtained in only two-thirds of the cases in this small series. Fair results or failures occurred in microaerophilic hemolytic streptococcus infections (2 cases,) varicose ulcers (2 cases), arteriosclerosis (1 case), coccidiodes (1 case) and acrodermatitis chronica atrophicans (1 case). Three of these cases were of less than one and one-quarter years duration. Recurrences have already occurred in nearly 30 per cent of the patients including 5 who were listed as "good" results.

The results obtained with anhydrous lanolin alone were almost equal to those that followed the use of equal parts of cod-liver oil and anhydrous lanolin. In a general way, the advantages and disad-

vantages of the treatment of ulcerations of the skin with cod-liver oil apply to the use of anhydrous lanolin. In this series, cod-liver oil applied locally did not prove itself to be a satisfactory method of treating skin ulcers. However, the prompt relief of pain that usually follows the application of this preparation suggests that it may prove to be a valuable addition to the other means of treating ulcers that are now being employed. It is certain that it should not supplant therapy aimed at correcting basic etiological factors.

SUMMARY

1. Equal parts of cod-liver oil and anhydrous lanolin applied locally healed ulcerations of the skin in two-thirds of the patients in this series.

2. Anhydrous lanolin alone gave comparable results.

3. It is possible that the vitamin content of the oil enhances its healing powers by stimulating epithelialization.

4. Cod-liver oil alone does not constitute sufficient treatment as it does not offer permanent results in the majority of ulcerations of the skin.

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LYMPHOSARCOMA OF STOMACH: CLINICAL AND ROENTGENOLOGICAL ASPECTS

REVIEW OF RECENT LITERATURE; REPORT OF A CASE*

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THE recognition of a malignant gastric lesion as a rule does not present much difficulty in diagnosis. Gastric carcinoma, in the majority of instances, is readily recognized and the roentgen study affords conclusive evidence. However, the foregoing cannot be claimed for gastric sarcoma since this neoplasm may simulate in its earliest manifestations, carcinoma or even a benign lesion. There are no characteristic signs or symptoms for sarcoma, and early diagnosis may offer extreme difficulty for the clinician. At times the pathologist is puzzled, even with his gross tumor and sections to guide him, as some infiltrating cellular carcinoma with anaplastic cells may closely simulate sarcoma and some believe, have been reported as carcinoma. Besides, the secondary tumor nodules of quite typical sarcoma strongly resemble carcinoma and hence may readily lead to error in diagnosis.

That pathological difficulties do arise, is well shown by Freeman who reported a case of gastric sarcoma in which noted pathologists presented a diagnosis of carcinoma, lymphosarcoma, inflammatory tissue and chronic granuloma.[1]

The age as given in the literature varies exceedingly. Finlayson reports a case of a child three and one-half years old, whereas Gosset records a case with the age of eighty-five years. The average age is about forty years, whereas in carcinoma, it is fifty-five years. In the Mayo clinic, the age of the youngest case reported is ten years, the oldest is sixty-seven years and the average is forty-three years. These figures confirm the opinion that one obtains from the literature, that sarcoma occurs earlier in life than carcinoma and that it is about equal in both sexes. In the Mayo Clinic the ratio is 3 males to 1 female.[2]

SYMPTOMATOLOGY

This presents a much varied picture as viewed in the literature, particularly in the last few years.

From symptomatology one is unable to differentiate sarcoma from carcinoma of the stomach, as no one symptom or group of symptoms can be considered characteristic; the presenting complaints of dyspepsia, pain, tumor, bleeding, weakness, loss of weight, vomiting and anemia are common to both conditions. In some cases the symptoms of peptic ulcer predominate.[3] According to Cecil,[4] the general health may be better than gastric cancer. Tremendous hemorrhages may occur from which there may be recovery with periods of remission. The case we are about to report, exhibited general good health and the blood picture was normal although the loss of weight was moderate, about twelve to fifteen pounds in six months.

The authors' case, to add to the complexity of diagnosis, presented a four plus spinal Wassermann and had intensive antileutic treatment at intervals covering a period of about twelve years. As syphilitic infiltration may occur in patients presenting an epigastric mass such as our case exhibited, this possibility was borne in mind. In our comments of the reported case more details are offered concerning the diagnosis of gastric syphilis.

Hameed[5] reports a case of gastric lymphosarcoma presenting an intense anemia, optic neuritis and some wasting of the muscles of the extremities. The

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symptoms did not indicate a new growth and whether the toxic condition accounted for the neuritis or active infiltration of the spinal cord and its nerves, remained undetermined as permission to remove the spinal cord was withheld. Leucopenia and a relative increase in lymphocytes constituted the main findings in the blood picture.

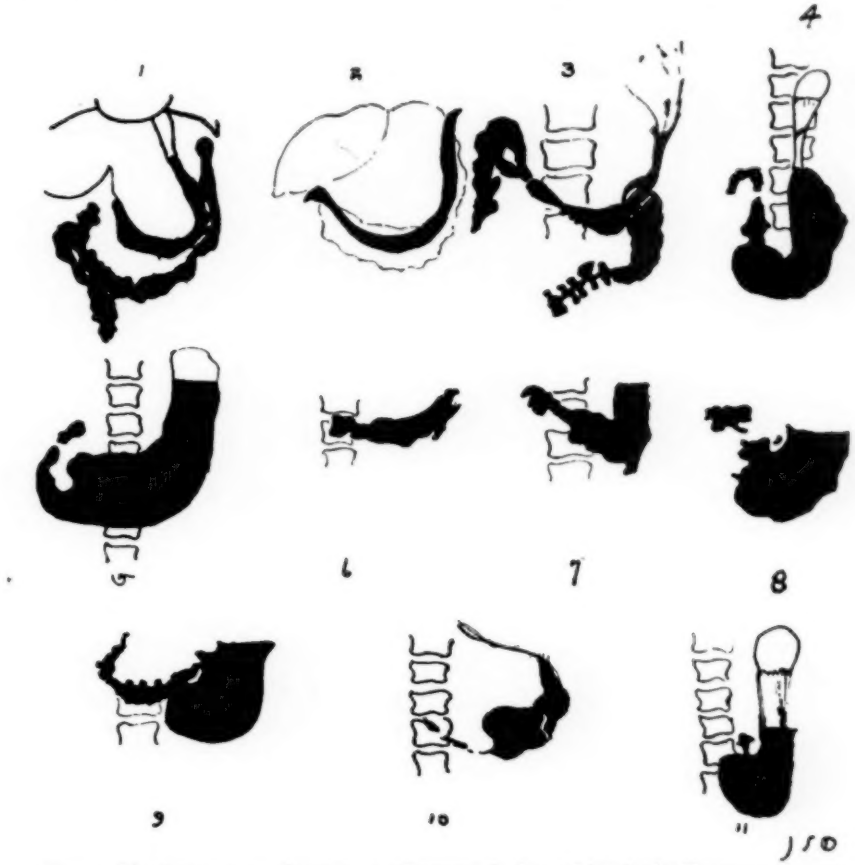

FIG. 1. Various types of sarcoma of stomach, from histologically proved cases: 1, broad based exogastric sarcoma of lesser curvature, myosarcoma (Gosset); 2, exogastric sarcoma of lesser curvature, myxosarcoma (Heller-Konjetzny); 3, broad based exogastric sarcoma of lesser curvature, polymorphocellular sarcoma; 4, broad based exogastric sarcoma of greater curvature, spindle cell sarcoma (Ludin); 5, endogastric sarcoma, spindle cell sarcoma (Geymüller); 6, sarcoma of greater curvature, lymphosarcoma; 7, infiltrating sarcoma of anterior wall, extending from antrum to pylorus, reticulosarcoma (Jaki); 8, sarcoma of lesser curvature, large cell type of round cell sarcoma (Bohmansson); 9, sarcoma of pylorus, round cell sarcoma (Bohmansson); 10, infiltrating tumor of cardia extending to pylorus, lymphosarcoma (Nissen); 11, circular stenosing tumor of pylorus, lymphosarcoma. (The Year Book of Radiology, Chicago, Year Book Publisher, 1935, p. 208.)

Harper[6] reports a case of lymphosarcoma of the stomach in a man of sixty years, who thirteen years previously had a cervical node excised, pathologically sarcomatous. Nine years later, an exploratory laparotomy disclosed extensive lymphosarcoma of the cecum with involvement of the glands along the ureter and invaded the peritoneum. No surgery was attempted but the case received intensive irradiation. Five weeks prior to admission, the patient vomited about 50 c.c. of fresh blood. Balfour excised a large tumor of the stomach, for fear of another hemorrhage, and found lymphosarcoma. A jejunostomy was performed for feeding. Microscopical examination of the tumor revealed the same type of tissue as found in the cecum nine years previously.

Husted[7] believes that most cases of gastric sarcoma are discovered at autopsy with a few cases found at operation,

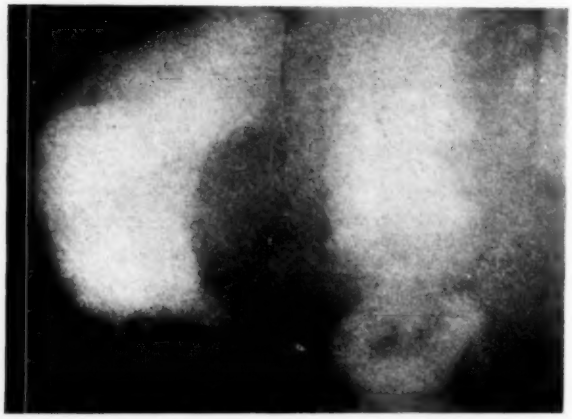

FIG. 2. Lymphosarcoma of stomach. Note marked defect of horizontal portion with canalization of the antrum. Irregularity indistinguishable from carcinoma or syphilis, although indented relief suggests sarcoma.

and are rarely recognized clinically. Melena or occult hemorrhages seem fairly constant. Muscatello[8] reports a case of primary lymphoblastoma of the stomach with metastasis to the ovaries. Cain, Hillemand and Mezard[9] differentiate Hodgkin's disease, generalized lymphosarcoma and local sarcoma of the stomach. They believe there are no outstanding clinical signs or symptoms.

Balfour and McCann[10] reported a series of 54 cases of sarcoma of the stomach which were studied at the Mayo Clinic from January, 1908 to July, 1929, inclusive. Diagnosis was made in all cases as a result of operation except one in which sarcoma was found at necropsy. In 5 cases no tissue was removed at operation and the diagnosis was based upon the gross appearance of the inoperable tumor. To again demonstrate the difficulty of diagnosis, the pathologist reported the possibility of cellular carcinoma in 3 cases and one case involved the stoma of a gastroenterostomy. A total of 4159 cases of gastric malignant lesions were grouped of which 45 were proved gastric sarcoma, and 9 were probable sarcoma. Their figures[10] are tabulated (Table 1).

TABLE 1
COMPARISON OF FREQUENCY OF SARCOMA AND CARCINOMA*

Period	Sarcoma	Carcinoma	Ratio
1908–1915	5	1131	1:226
1916–1920	15	973	1:65
1921–1925	21	1185	1:56
1926–1928	6	823	1:137

* Balfour and McCann.

Haggard[11] collected from the literature 244 cases up to 1920 and reported an analysis of 107 operated cases.

OBSERVATIONS OF ROENTGENOGRAPHIC DIAGNOSIS OF SARCOMA OF STOMACH

In 4509 malignant tumors of the stomach operated in 7 clinics in various parts of the world, 48 sarcomas were found. If after a roentgen examination, primary sarcoma is considered, the probability in diagnosis is slightly over 1 per cent. Causes are unknown and it is believed that sarcoma does not originate from ulcer although an ulcer history is elicited in some cases.

Localization is said will permit a probable diagnosis. It appears as a single tumor; if multiple, metastases of a primary tumor are probable. In 48 cases from the literature, the site was found in the greater curvature 14 times; in the pylorus 14 times; in the lesser curvature 11 times; the posterior wall 6 times; the anterior wall 8 times. Diffuse infiltration was found 4 times and the cardia was the seat of the tumor in one case. Pyloric stenosis is unusual.

In histologic structure, primary sarcoma of the stomach may be round cell sarcoma, lymphosarcoma, spindle cell sarcoma, fibrosarcoma, myosarcoma and polymorphocellular sarcoma. Other forms are rarer.[12]

In about one-half of the cases Eusterman and Balfour[2] were able to demonstrate a tumor mass, although in their series a few of the cases presented themselves with a mass as a leading symptom. The tumor may be fixed, move with respiration, or

may be only palpable in the standing position. In the few cases where pyloric obstruction exists, gastric peristalsis may be seen occasionally. The size of the tumor may vary from 3 cm. to include almost the entire stomach by massive infiltration.

The same authors report that the location of the tumor is frequently in the antrum but usually far enough from the pylorus as to rarely obstruct it. In one of their cases the lesion caused pyloric obstruction and in another the lesion passed beyond the pylorus into the duodenum. They found that the cardia was never involved. The more common situation was the lesser curvature, but the greater curvature, anterior and posterior walls, were also the sites of origin. In inoperable cases tumors involving the pancreas and extending into the omentum were reported. Occasionally, a secondary mass was found in the pelvis or associated multiple small tumors in the colon.

In some cases the mucosa is intact, whereas in others, the defect ranges from perforation of 1 mm. in diameter to extensive areas of ulceration. Frequently patients who give histories of gastrointestinal hemorrhages had ulceration or perforation.[2]

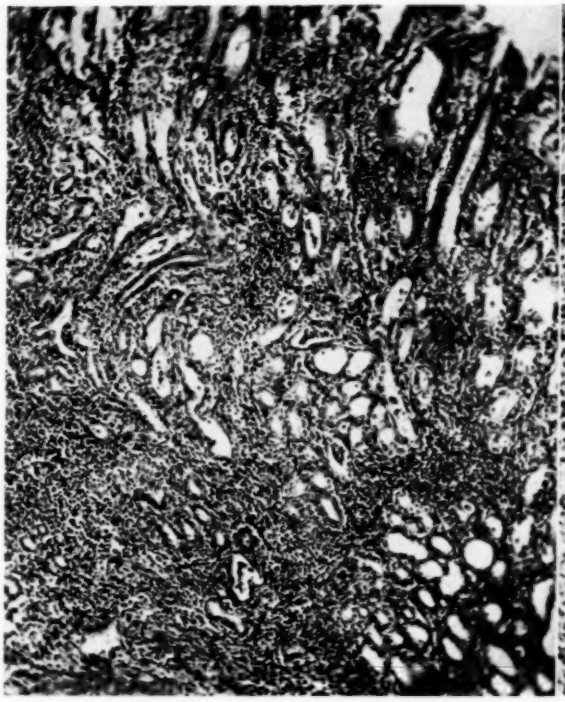

Fig. 3. Gastric lymphosarcoma. Photomicrograph of a section through the stomach. Note the heavy infiltration of the mucosa and the submucosa by tumor cells. (× 65.)

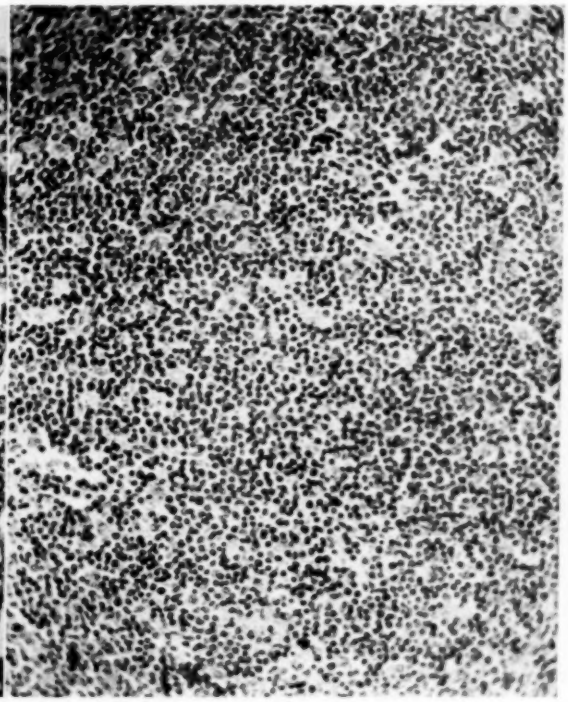

Fig. 4. Lymphosarcoma of lymph node (metastatic). Photomicrograph of a section from the periaortic lymph node. The normal architecture is obscured by the dense infiltration of large lymphocytes and proliferated reticulum cells. (× 135.)

Rentschler and Travis[13] reported a case of gastric lymphosarcoma and tuberculosis occurring simultaneously in a female, aged sixty-five years, who gave a peptic ulcer history of seventeen years duration. There were no hemorrhages but the patient presented a secondary anemia.

Syphilis of the stomach may greatly resemble lymphosarcoma. The characteristic lesion of syphilis has been described as a flat plaque-like infiltrate which primarily involves the submucosa and its distinctive feature is its soft consistency.[14] This relatively flat tumor combined with its softness may escape detection, two characteristics that an infiltrating sarcoma of the stomach wall may possess, although the

degree of consistency may be more firm in sarcoma.

The following is a comparative group table of the essential clinical factors taken from the Mayo Clinic by Balfour and McCann[10] and from seven clinics in various parts of the world as published in the 1935 Yearbook of Radiology. Mention in the latter is made of Kundrat's symptom, a swelling of the lymph follicles at the base of the tongue, important for differential diagnosis; according to Konjetzny, it favors regional aleucemic lymphomatosis of the stomach in cases that present a palpable tumor.[15]

TABLE II

Balfour and McCann[10] Mayo Clinic	Seven clinics from various parts of world.[15] Group facts and figures 4509 malignant tumors of stomach.
4159 malignant gastric tumors	48 gastric sarcoma.
45 proved sarcoma; 9 probable; total 54	
Age.	
No. Cases: Years 10 to 20 — 2; 20 to 30 — 7; 30 to 40 — 7; 40 to 50 — 16; 50 to 60 — 12; 60 to 70 — 10	Begins between 20 to 30 years, rises rapidly, failing rapidly, in seventh decade.
Sex.	
31 males 13 females	No significant difference.
Clinical Features.	
Varied from localizable gastric disorder to indefinite general abnormal conditions, not indicating seat of disease.	Course may be symptomless or perforation and hemorrhage with death; vomiting in about one-half reported cases (vomitus seldom coffee ground). Palpable tumor more frequent than carcinoma. Blood in stool and secondary anemia, same frequency as in carcinoma. Acidity often lowered but absence of free HCl is not so common as in carcinoma.
Chief Complaints. No. Cases: Dyspepsia 23; Epigastric pain 19; Bleeding 3; Weakness and loss of weight 3; Vomiting 2; Demonstrable epigastric tumor 26; History of G.I. hemorrhage for period of one to nine months 16; Fatal hemorrhage 1	Cachexia appears relatively late.
Hemoglobin varied from 88 to 24 per cent.	
Gastric chemistry in 42 cases, free HCl absent in 17.	
Weight Loss.	
Ranged from 5 to 70 pounds in period varying from two to several years; average loss 23 pounds in four months. Had no loss of weight up to time of operation, in 11 patients.	Weight curve similar to carcinoma.
Roentgen Studies.	
In 45 cases studied, malignant lesion 35 cases; ulcer 3 cases; extragastric tumor, 2 cases; possible benign tumor, 1 case; negative, 5 cases.	Not given.

Emma Kessler reports 4 cases of gastric sarcoma, 3 primary and one which was metastatic from sarcoma of the tonsil. None of the tumors could be diagnosed clinically but the roentgenographic and clinical findings differed from carcinoma.

CASE I. A man, aged forty-two years, showed a peculiar filling defect on the midportion of the greater curvature with smooth margins, painful on palpation at this site. Lymphosarcoma was found at operation.

CASE II. Male, aged twenty-six years, with pyloric stenosis as his chief symptom. Roentgenographic examination showed a circular tumor at the pylorus, which did not look like carcinoma. A round cell sarcoma, rich in microcytes was found.

CASE III. Male, aged forty-eight years, had a rapidly growing tumor in the upper abdomen without objective symptoms. Roentgenologic examination showed a huge tumor in the epigastrium above the lesser curvature which was not movable on the stomach. A cystic tumor of the pancreas was suggested and was maintained, even after exploratory laparotomy, but autopsy showed polymorphocellular sarcoma arising from the lesser curvature.

CASE IV. This case in a fifty-six year old male, was secondary to a reticulothelial sarcoma of the tonsil which disappeared after fractionated irradiation. Later a nodular filling defect was seen roentgenologically, beginning at the cardia and including the upper third of the lesser curvature. In the fundus, the tumor was recognizable as a soft parts shadow. In the upper third of the greater curvature, a defect the size of a hen's egg was seen. Simple fractionated irradiation, 360 *r* to each of the two fields, was applied and the gastric picture became normal. A retroperitoneal infiltrate was later demonstrated and successfully irradiated. The patient finally died but no autopsy was done.

Kessler[16] has investigated the relationship between the roentgenologic picture and the histologic type of sarcoma and the following diagram shows the types. (Fig. 1.) Kessler is of the opinion that smoothness of contour should suggest sarcoma but at times sarcoma presents an indented relief. When the tumor alone is found on the greater curvature and lacks the typical

saucer shape of carcinoma at this site, sarcoma is to be strongly considered. This author establishes these criteria, which in special cases taken together, may make the diagnosis. However to these criteria will be added others as further cases are studied, and detailed observations and roentgenologic studies are made.

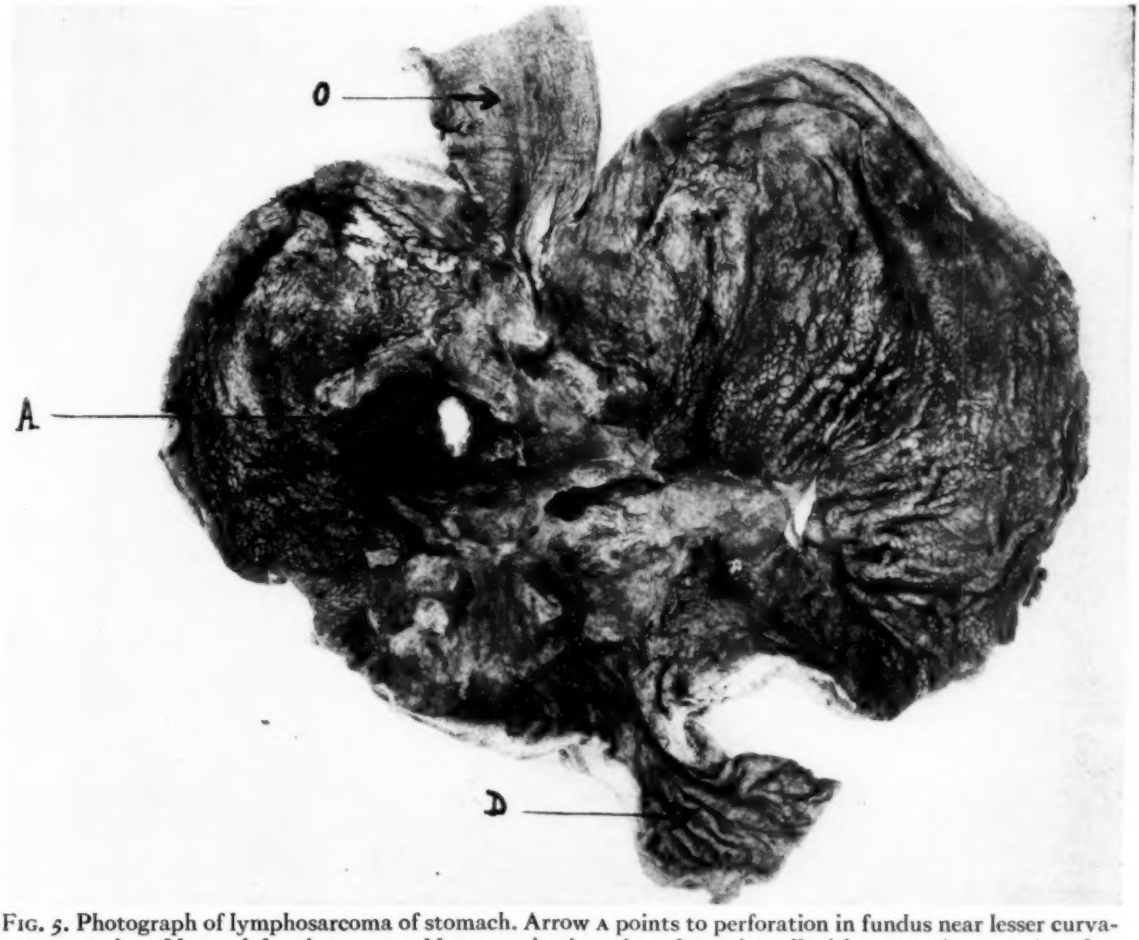

FIG. 5. Photograph of lymphosarcoma of stomach. Arrow A points to perforation in fundus near lesser curvature at site of large defect in mucosa. Note massive invasion of gastric wall with tumor tissue. O, (esophagus,) D; duodenum.

Kandrnka and Sierro, of Geneva, are of the opinion that no clinical syndrome is characteristic of all forms of primary gastric sarcoma, however, they believe that in two of the three groups, it is possible, by their anatomic image, to render a diagnosis without histologic examination. These two types are the endo- and exogastric pedunculated tumors.

The endogastric pedunculated tumor has a rounded form with smooth borders and the mucosa ulcerates rapidly; it does not infiltrate the adjoining walls of the stomach. Mechanical disturbances, hemorrhages, anemia, cachexia, etc., most often lead to its discovery. The characteristic radiologic signs are a rounded lacuna with distinct borders and relative mobility with regard to its gastric walls. There is a persistent notch in the curvature adjacent to the tumor, corresponding to implantation of the pedicle. The mucosa is supple where peristalsis occurs.

In exogastric pedunculated sarcoma, signs of compression of the neighboring abdominal organs, displacement or dislocation of the stomach must be sought. A cone of attraction at the foot of a narrow pedicle and small irregular contours in the walls of the stomach may be present; mucosal lesions are not usually seen.

They believe that from the anatomo-macroscopic standpoint, the diagnosis of intramural and lymphosarcoma is difficult, tumor are factors which may suggest sarcoma. To these may be added roentgen ray therapy; if the size of the tumor is

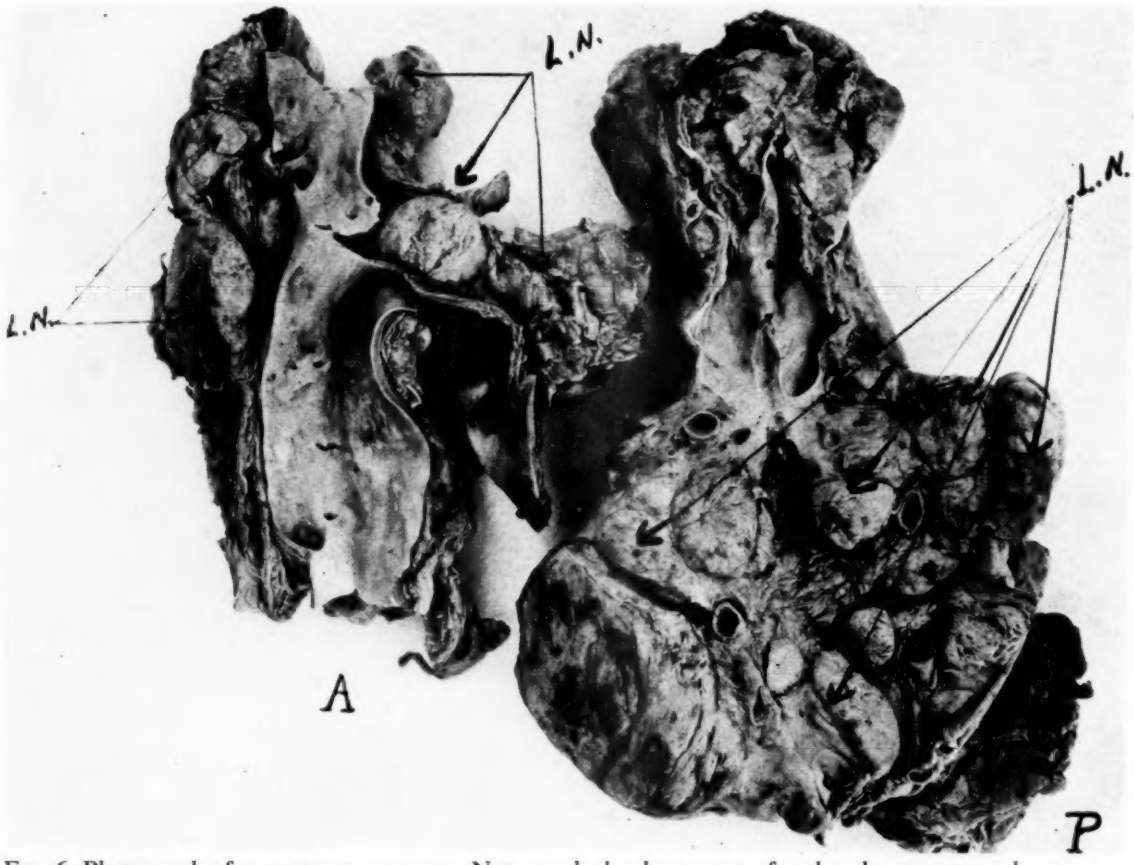

FIG. 6. Photograph of A, aorta; P, pancreas. Note marked enlargement of nodes about aorta and pancreas. L.N., enlarged masses of lymph nodes (metastatic from gastric lymphosarcoma).

if not impossible. This type of tumor infiltrates the gastric wall, spreads by nodular dissemination which becomes confluent rendering a homogeneous appearance to the mass and greatly simulates the appearance of a carcinoma. The radiologic signs of rigidity of the gastric wall, stenosis with canalization, stricture and even stenosis go hand in hand with carcinoma and it is impossible to differentiate. Biopsy through exploratory laparotomy or preferably an external node, as the supraclavicular node, if found, offers the safest means for certain diagnosis. The authors' case presented similar roentgenographic manifestations. Kundrat's sign, splenomegaly, continuous fever and persistent peristalsis at the level of the diminished, the clinical diagnosis of sarcoma may be entertained.[17]

Spitzenberger,[18] of Vienna, is of the opinion that when the tumor mass proliferates through the diaphragm embarrassing the heart, that it is more likely to be sarcoma than carcinoma. The greater curvature of the fundus, he believes is the predilected site for sarcoma, whereas in carcinoma the cardia is more frequently attacked. He reports a case of a large tumor of the fundus which proliferated through the diaphragm and which histologically proved to be lymphosarcoma. This tumor infiltrated the spleen causing marked enlargement of the organ and produced a large shadow defect in the fundus involving the greater curvature.

PATHOLOGY

Voeckler[19] reports a series of 130 cases operated for malignancy of the stomach in which were 4 cases of sarcoma, an incidence of 3 per cent. In a small series this percentage may occur as much larger series reveal an incidence slightly over one per cent. He mentions the exogastric, endogastric, and intramurald types and histologically, (1) *a.* round cell; *b.* spincle cell; (2) lymphoid; (3) fibro- or myosarcoma; (4) polymorphocellular; (5) mixed cell (lymphocytic and reticulum), (6) angio- or lymphangiosarcoma.

The exogastric type predominates. To this group may be included the reticulothelial sarcoma. (Refer to Case IV in Kessler's group of a metastatic gastric sarcoma following a primary sarcoma of the tonsil.)

In a pathologic study of 40 operated cases at the Mayo Clinic[2] the following histologic types were found: lymphosarcoma 32; fibrosarcoma 5; myosarcoma 3.

As lymphosarcoma is the most susceptible to irradiation, this type offers the most in roentgen therapy.

ROENTGEN SIGNS

There are no roentgenographic signs, as has been stated, which can be considered pathognomonic of sarcoma. In fact, irregular shadows cast by malignant tumors as a whole remain undifferentiated. From the literature one may entertain a consideration of sarcoma if the tumor is flat and possesses smoothness of contour. An indented relief of outline also strongly suggests sarcoma. Suspicion should be strongly aroused if the tumor alone is located on the greater curvature and looks the typical saucer shape of carcinoma. If extensive infiltration of the wall has occurred, the pars media is replaced by a narrow channel which presents an indented relief much smoother in outline than the gross irregularities exhibited in carcinoma (authors' case). Peristaltic waves are dependent upon the amount of infiltration of the gastric wall; if infiltration is small, little or no variation will be met in the gastric outline. However, if the intramural infiltration is extensive, peristalsis will be notably absent. These are the roentgenographic signs for the intramural type of sarcoma.

Already reference has been made in the paragraphs on pedunculated tumors, the endo- and exogastric forms of their radiologic signs.

DIAGNOSIS

Rarely is a diagnosis made before operation as signs and symptoms of any malignancy closely resemble each other. Roentgenologic examination is of the utmost value particularly to estimate the operability of the lesion. But the court of the last resort should be placed in the hands of the surgeon, to explore the lesion, as the surgeon may encounter a large mass sometimes possible of removal even though the roentgen ray reveals extensive involvement of the tumor as an inoperable growth.

Balfour reasons that certain sarcomata are not of the infiltrating type and the line of demarcation is definite. They may even appear to extend into neighboring organs and their origin may be determined by fluoroscopic examination. He found that some tumors perforated and had become fixed to adjacent organs so that at first glance, when the abdomen was opened, they appear impossible to remove. After carefully separating the organs the tumor was found confined to the stomach wall and had not extended beyond it, thus justifying the attempt of removal. If the tumor is in a young child, or in the second or third decade of life, suspect sarcoma. The same author emphasizes exploration of any gastric tumor or lesion unless it is perfectly obvious that the growth is inoperable. Until the diagnosis is proved by pathologic study, the problem is always a question and the

patient should be given the benefit of the doubt whenever possible.[2]

SUMMARY

The difficulties of recognizing sarcoma of the stomach are enumerated as the clinical signs closely resemble carcinoma. Local involvement of the stomach associated with an almost normal blood picture in which hemorrhage with recovery has occurred should lead to a probable diagnosis of sarcoma. If in addition, the roentgenographic findings demonstrate a smooth flat tumor or one with a deeply indented relief, sarcoma is a very likely diagnosis to be entertained. The possibility of rendering roentgen ray therapy once a diagnosis is established, may lead to complete regression of the tumor and may offer the most to the patient. It is needless to add that surgical exploration and biopsy are advised, as much can be gained from the information obtained as to the extent and nature of the tumor, and type of therapy to be advised. Cases from the recent literature are briefly reviewed notably those from the 1935 Year Book of Radiology. The authors' case is reported with all the data included.

HISTORY

N. D., male, aged fifty years, was admitted to Woodlawn Hospital August 26, 1935, with a tentative diagnosis of gastric lues or carcinoma. He complained of epigastric distress, of three years duration.

Onset and Course. Three years ago, the patient began to notice a periodic sensation of burning and fullness in the epigastrium occurring about three hours after meals; the time was regular. He was often awakened at night by the same distress which was at once relieved by taking soda. There were frequent remissions, some lasting several weeks. He soon discovered that bland foods agreed, whereas, meat, vegetables, etc., brought on an attack. He had no nausea or vomiting, no hematemesis. At onset he was worried by business difficulties. No abdominal pain. Occasionally he suffered from facial neuralgic pains and diplopia.

Sexual History. He had a positive spinal Wassermann in 1921, but denies chancre; although he had diplopia and facial pain, he never had a rash. He had yearly courses of mercurials, bismuth and arsenicals since. Married since 1928; no children; wife had no miscarriages.

Physical Examination. A well developed and nourished male lying quietly in bed, not acutely ill; his weight was about 175 pounds showing a loss of about twelve pounds in six months. The head was negative. The pupils reacted to light and accommodation. The ears and nose were negative. Except for poor teeth, the mouth was negative. His neck showed slight adenopathy, and a palpable, but not enlarged thyroid. Other than few crackling rales over both lung fields, nothing remarkable was found. The heart was negative. The abdomen presented no masses or tenderness; liver border smooth, palpable, and slightly enlarged. A slight hydrocele was noted. Skin showed papules on the back. Bones and joints: no tenderness or deformities. Reflexes: knee jerks active, bilateral; abdominals not elicited; Babinski, negative. Temperature 98; pulse rate 94; respiration 12.

ROENTGENOLOGIC STUDY OF GASTROINTESTINAL TRACT

In the G.I. tract the esophagus is normal. The stomach is steerhorn in type, moderately large at the cardiac end which is somewhat dilated with a large defect in the pars media and with canalization consisting of a narrow thin irregular stream as far as the pylorus. On the lesser curvature the irregularity extends to within 5 cm. of the cardiac end. Periodically there is at times a continuous stream of barium passing through the pylorus and outlining the entire duodenum. Peristalsis is definitely diminished and is absent in the involved area. Nothing of note was seen in the five and twenty-four hour observations (Fig. 2).

The urine was negative.

The blood findings showed white blood corpuscles 9600, red blood corpuscles 4,470,000, and hemoglobin 80 per cent. The differential count revealed polymorphonuclear neutrophiles 79 per cent, polynuclear eosinophile 1 per cent, small lymphocytes 18 per cent and large mononuclear 2 per cent.

Gastric analysis after introduction of 100 c.c. 7 per cent alcohol gave the following results:

Time, Minutes	HCl	Total Acid	Blood
20	None	5	negative negative
40	None	4	negative negative
60	None		

Benzidine blood was negative.

The patient was discharged August 28, 1935, condition unchanged.

In view of the fact that we were definitely dealing with a malignancy of the stomach, grossly inoperable, and with a syphilitic history, antiluetic therapy was the first treatment of choice.

The patient was readmitted September 6, 1935 with recurrence of symptoms. On the day of readmission, he vomited a large amount of blood. He had several attacks of repeated vomiting, much less severe and observed small quantities of blood in the vomitus. This has been the first instance of a hematemesis. He had had no tarry stools. Blood count revealed 21,400 leucocytes with polymorphonuclears 89 per cent and small lymphocytes 4 per cent.

Nodes were now palpable in the left supraclavicular fossa, a very tender group in the left submaxillary region, a node felt in the left epitrochlear and inguinal regions and flat circular mass was felt in the left epigastrium extending under the costal border. He was treated with neoarsphenamine as the history and findings favored gastric lues. The nodes in the left supraclavicular region become more numerous. The patient developed more hemorrhages and on October 4 sustained a perforation, expiring October 5, 1935.

Essential Pathological Postmortem Findings. Abdominal Cavity. The liver extends 6 cm. and 3 cm. below the xiphoid process and the right costal margin. The intestines are distended and matted together by loose fibrinous adhesions. The serosa of the bowel is discolored a purple-gray and cloudy. There are about 500 c.c. of a blood-tinged purulent fluid present. The transverse colon near the hepatic flexure is adherent to the gall bladder.

Gall Bladder. The wall is thickened and the mucosa is a light yellowish-tan. In the serosa there are several pinhead sized firm gray nodules.

Stomach. Contains about 1500 c.c. of uncoagulated blood. The mucosa is deeply injected, purple-red and presents many shallow defects. Up to 15 mm. in diameter, beginning 35 mm. above the pylorus in the region of the lesser curvature, there is a huge defect extending up to the cardiac orifice and measuring 105 by 135 mm. The edges of this defect are firm, elevated and ragged. The floor of the ulcer is discolored a dirty purplish-green. In the upper portion of the defect there is a perforation 20 mm. in diameter, communicating with the peritoneal cavity, and is loosely sealed by the inferior surface of the left lobe of the liver. The perigastric lymph nodes are matted together forming a plate 14 by 6 by 2 cm. The inguinal lymph nodes are up to 20 mm. in diameter. The peripancreatic lymph nodes are enlarged up to 30 mm. in diameter, soft, purple-gray and medullary (Figs. 5 and 6).

Microscopic Examination. Stomach. Throughout the mucosa there are accumulations of large lymphocytes. The cells infiltrate the submucosa forming masses and then are seen extending into the muscularis propia. In the region of the ulceration, the mucosa is completely replaced by dense masses of tumor cells, resembling large lymphocytes (Fig. 3).

Studies of the various lymph nodes reveal a uniform picture in all. The normal architecture is completely obliterated by the dense proliferation of small round cells, resembling lymphocytes. Only strands of trabecula are seen and they are invaded by lymphocytes. The cells contain an oval to round nucleus. The nuclei are composed of a coarse, dense, granular chromatin material. Mitotic figures are numerous. The sinuses are infrequently lined by large, swollen and vacuolated reticular cells. The histological studies reveal a lymphosarcoma of the stomach with extensive metastases to the lymph nodes (Fig. 4).

Anatomical Diagnosis. 1. Lymphosarcoma of the stomach with ulceration and perforation into the abdominal cavity.

2. Metastases to the perigastric, peripancreatic, periaortic, inguinal and supraclavicular lymph nodes.

3. Diffuse fibrinopurulent peritonitis.

COMMENT OF CASE

A review of the symptomatology and laboratory data of this patient, especially the roentgenographic findings, indicated an advanced neoplastic lesion, infiltrating

in type, involving the antrum and the greater part of the corpus of the stomach. The blood picture at the time of the first admission was essentially normal and with a luetic history suggested the possibility of gastric lues. Gastric carcinoma was the first diagnosis of choice from the roentgenological findings but the normal blood picture spoke against cancer as marked secondary anemia usually accompanies advanced gastric carcinoma. The absence of cachexia in such an extensive lesion combined with a normal blood picture and relatively slight loss in weight, drew the inference that we were dealing with pathology other than carcinoma. The history leaned more toward gastric lues. Lymphosarcoma was not considered although malignancy was borne in mind.

The autopsy findings of a smooth massive gastric infiltration extending into the left lobe of the liver at which point the gastric wall was perforated and the extensive metastases to the surrounding nodes of the pancreas, stomach and aorta indicated sarcoma, which microscopical study confirmed.

SUMMARY

While gastric malignancies offer no great diagnostic difficulties, the pathological and clinical differentiation between gastric carcinoma and sarcoma is difficult. A review of the literature indicates that the diagnosis of gastric sarcoma is rarely made preoperatively. However, local involvement of the stomach, associated with an almost normal blood picture in a patient with a history of hemorrhage and recovery, as well as roentgenographic findings of a smooth, flat tumor or one with a deeply indented relief suggests the possibility of sarcoma. The *x*-ray picture is of particular value in estimating the operability of the lesion and may be of therapeutic value.

A case is reported of a male, fifty years of age, in whom a clinical diagnosis of either gastric malignancy or gastric lues was entertained, but autopsy studies revealed the mass to be a lymphosarcoma with ulceration and perforation into the abdominal cavity and with metastases to the perigastric, peripancreatic, periaortic, inguinal and supraclavicular lymph nodes.

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TREATMENT OF ABORTION*

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THE term abortion is applied to all cases of pregnancy terminating before viability of the fetus, i.e., up to the twenty-eighth week. They are classified as threatened, inevitable, incomplete, septic, complete, or missed abortion. We will consider the history, the findings, and the treatment of each type separately.

THREATENED ABORTION

History. One can usually elicit a history of amenorrhea with the associated symptoms of pregnancy referable to that period; such as nausea, vomiting, fullness and tenderness of the breasts, and frequency of urination. Bleeding is slight and often mixed with mucus. Pain is usually absent or the patient may complain of vague intermittent backache.

Findings. Vaginal examination should be limited to those cases in which the presence of an intrauterine pregnancy is doubtful. This should be performed with gentleness and under rigid asepsis. The findings are slight vaginal bleeding, the cervix is soft, and the external os is closed. The uterocervical angle is present. The size of the uterus corresponds with the period of amenorrhea, and is soft in consistency.

Treatment. Treatment is aimed at eliminating or preventing uterine contractions and controlling the bleeding. This is done by putting the patient to bed, eliminating enemas and cathartics, and administering intramuscularly morphine sulphate grain ¼ every six hours, and one rabbit unit of progestin daily until the bleeding and pain have ceased. Following this, the patient is kept in bed for seventy-two hours and on discharge is cautioned against vigorous activities. If the uterus was found retroverted, the patient is advised to assume the knee-chest position for ten minutes three times a day.

INEVITABLE ABORTION

History. The initial symptom may be premature rupture of the membranes with the escape of amniotic fluid. In other cases the onset is similar to threatened abortion, but with time, bleeding becomes more profuse and mixed with clots. Pain is a constant symptom and is described by the patient as being intermittent, cramp-like, and localized to the lower part of the back and abdomen.

Findings. The vagina is filled with blood. The cervix is soft, and the external os is patulous. Through the dilated cervix part of the ovum frequently protrudes. The uterocervical angle is absent. The uterus is soft and enlarged to correspond with the period of amenorrhea.

Treatment. Since the pregnancy can no longer continue our aim is to hasten its termination. Where bleeding is slight, expulsion of the products of conception can be quickened by stimulating uterine contraction. To do this a warm enema, a hypodermic injection of an ampule of obstetrical pituitrin, plus the oral administration of quinine grains 5, at two hour intervals are given for two doses.

Interference becomes imperative if the patient is hemorrhaging. Careful aseptic technique must be followed with every surgical procedure. In the afebrile case, the method of choice depends upon two factors: i.e., the dilatation of the cervix, and the duration of the pregnancy.

Up to the third month, if dilatation is not adequate, graduated Hegar dilators are used to open the cervix. Up to the eighth week the ovum is removed with a dull

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curette or a small ovum forceps. After this period, one finger in the uterus, alone, or in combination with an ovum forceps, is employed to remove the retained products.

Following the third month, cervical dilatation is facilitated by the use of a tight vaginal pack soaked in 4 per cent mercurochrome. This is removed at the end of twenty-four hours. Then one of two things will usually be noted; either the uterus will have completely emptied itself, or the cervix will be found sufficiently dilated to permit the insertion of one finger into the uterine cavity with which the placenta can be separated off the uterus and then easily removed with a placental forceps.

INCOMPLETE ABORTION

History. If part of the ovum is left behind, bleeding occurs in varying amounts. This type of abortion is most apt to take place before the ovum becomes firmly attached to the uterus, i.e., after the eighth week. The fetus is usually expelled, and part or the whole of the placenta remains behind in the uterus.

Findings. On vaginal examination slight or profuse bleeding is noted. The cervix is soft in consistency and the external os is patulous. The uterus is enlarged. Its size depends partially on the duration of the pregnancy, but mainly on the amount of tissue left in the uterus.

Treatment. In the aseptic case, prompt evacuation of these products is advocated to minimize the blood loss and the possibility of infection. The methods employed are similar to those described under the treatment of inevitable abortion.

SEPTIC ABORTION

History. All criminally induced abortions are potentially septic. A history of chills and fever points to infection. Sepsis is substantiated by temperature elevation, high leucocyte count, and low sedimentation time. Uterine cultures afford some aid in determining the virulence of the infecting agent. A gentle bimanual examination will inform the physician whether the infection has extended beyond the uterus. The presence of pelvic tenderness, induration, or a mass in either or both fornices are evidences of such extension.

Treatment. In the presence of infection, active treatment is limited to those cases which are bleeding profusely. If the cervix is sufficiently dilated, the retained products are gently removed with an ovum forceps. This procedure usually controls the bleeding and institutes adequate drainage. On the other hand if the cervix is closed, bleeding can be controlled and cervical dilatation obtained by packing the vagina tightly with a mercurochrome soaked pack. The pack is removed at the end of twenty-four hours when sufficient cervical dilatation will be present to permit the removal of the retained products with an ovum forceps, or occasionally the products will have been spontaneously discharged from the uterus. Curettage is contraindicated in septic abortion because such manipulation tends to spread the infection beyond the uterus.

Where bleeding is negligible conservative treatment is advocated. This consists in placing the patient's bed in high Fowler's position, and stimulating uterine contractions by placing an ice bag to the lower abdomen, and administering ergotrate, pituitrin, and quinine. Fresh air, sunshine, highly nutritious foods, and frequent small blood transfusions of 300 c.c. every four days are important aids in building up the patient's resistance against the infection. This expectant treatment is followed until the temperature falls to normal and remains so for five days. If at that time, secundines still remain in the uterus they should be gently removed to hasten the patient's convalescence. In most instances the cervix will be adequately dilated to permit the removal of these fragments with a large dull curette or an ovum forceps.

COMPLETE ABORTION

History. This term is restricted to those cases in which all of the products of conception are expelled. It is most apt to occur before the placenta has become fully de-

veloped; i.e., before the twelfth week. A history of vaginal bleeding and intermittent lower abdominal pains preceding the abortion is usually obtained. After the expulsion of the ovum, pain ceases and is followed by a slight bloody vaginal discharge which persists for a few days.

Findings. The cervix is closed and a slight amount of blood issues from it. The uterus is moderately soft in consistency, and smaller than expected for the period of amenorrhea which preceded the abortion.

Treatment. The after care of all completed abortions is most important. The patient should be kept in bed until the dangers from complications have subsided and the bleeding has ceased for a week. During this period, uterine involution should be aided by the judicious use of oxytocics, and having the patient assume the knee-chest position. Mammary engorgement, appearing on the third or fourth day, is relieved by a tight breast binder and ice bags.

MISSED ABORTION

The term is applied to a pregnancy in which the fetus dies and is retained in the uterus for some time. Litzenberg places an arbitrary limit of two months after fetal death between abortion and missed abortion.

History. At the time of fetal death, the patient experiences slight vaginal bleeding in conjunction with vague intermittent uterine contractions. A diagnosis of threatened abortion is made and the patient apparently responds to treatment. As the weeks go by the patient senses that something is wrong. The symptoms of pregnancy cease. The breasts become smaller, the abdomen fails to enlarge, and fetal movements fail to appear. If death of the fetus occurs after the fourth month of pregnancy the patient notes a cessation of fetal activity.

Findings. The expected signs of pregnancy for the period of amenorrhea are lacking. Thus there is an absence of fetal life, and the breasts are smaller. Vaginal examination, in some cases, reveals a slight brownish discharge. The cervix is soft and the uterus is not as large as it should be. The Friedman test often becomes negative and is of inestimable value in those cases which previously yielded a positive result. After the fourth month, roentgenogram will show overlapping of the flat bones of the skull, a positive finding of fetal death. If the diagnosis is still doubtful, re-examinations will demonstrate a failure of the uterus to enlarge, and with time a diminution in its size is demonstrable by actual measurement.

Treatment. Spontaneous expulsion of the ovum takes place in the majority of cases with no untoward effects. Occasionally active treatment is necessary. In the early months of pregnancy the cervix should be dilated with graduated Hegar dilators and the ovum removed with a large dull curette or an ovum forceps. In the later months, anterior vaginal hysterotomy may be necessary before the products of conception can be removed.

PROPHYLAXIS OF ABORTION

The treatment of a spontaneous abortion is never completed until all possible factors which led to it are ascertained and appropriate methods employed to prevent its recurrence with subsequent pregnancies. With this thought in mind, the fetus and placenta should be carefully examined macroscopically and microscopically for a possible cause. Constitutional disturbances as anemia, syphilis, hypothyroidism, the presence of foci of infection, and nephritis should be ruled out and corrected by a thorough physical examination and a complete laboratory work up. If an altered carbohydrate metabolism or a diet deficient in calcium, or vitamins such as B and E, is the cause for the abortion, the proper steps must be taken to rectify such defects. The knee-chest position and the pessary should be employed to correct a retroverted uterus before and during subsequent pregnancies. A deeply lacerated cervix, or a uterine prolapse may occasionally demand

operative correction before allowing another pregnancy to occur. If the determined cause for frequent abortions lies in an adherent retroverted uterus, operative interference may be necessary to free the uterus and correct the displacement.

The husband must also be thoroughly examined, bearing in mind that many abortions are due to a defective germ plasm. Local evidences of infection, endocrine disturbances, or dietary deficiencies should be corrected. Antuitrin s, and theelin has produced favorable results in increasing the virility of the spermatozoa where a diminished activity existed.

When pregnancy occurs in a patient who habitually aborts, she should avoid strenuous exercises as dancing, swimming, horseback riding, automobiling, etc. Coitus should be eliminated especially during the first trimester of pregnancy. It is advisable to keep her in bed during those periods which would correspond to her menstrual flow had she not been pregnant, since it is found that abortion is more likely to occur at these times than at others. Progestin in one-half rabbit unit doses twice a week in the first trimester of the pregnancy is advocated, especially in those cases where the cause for the abortion points to an "irritable uterus."

SUMMARY

1. The history, the findings and the treatment of the various types of abortion are reviewed.

2. In the diagnosis and the treatment of abortions, all vaginal manipulations must be performed gently and aseptically.

3. In septic abortion, curettage is contraindicated.

4. The treatment of a spontaneous abortion includes a careful search for the factors responsible for this complication. If found they should be corrected or removed, if possible, so that subsequent pregnancies will go to term.

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HYPEREMESIS GRAVIDARUM*

ANALYSIS OF 50 CASES

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HOSPITALIZATION in hyperemesis gravidarum patently implies intractability with ultimate interruption of pregnancy versus conservative management and the proper timing of interference with the gestation being the paramount issue. An undivided responsibility for decision, and action thereupon, rests upon the consulting obstetrician. Sequels of observation, judgment and action are often distasteful, occasionally tragic. The consultant is forced into a paradoxical situation by a play of factors contributing to the production of as grave an obstetric situation as commonly obtains in practice. Chief of these are, on one hand, the fallacious, traditional expectation of "morning sickness" by the patient, and on the other, the optimistic outlook of the practitioner who anticipates cessation of nausea and emesis as a corollary of passing time. There is ample statistical justification for both these attitudes, yet, from the early disregard for what is considered a physiologic accompaniment of the first months of gestation, "morning sickness" insidiously progresses into the more vicious state termed pernicious vomiting. When emesis attains that point at which nothing taken by mouth is retained, when even the mention of food or drink actuates violent retching, with the pulse rate climbing, the blood pressure falling, the breath bearing a fruity odor and emaciation evident and advancing, long delayed therapy is sought and hospitalization generally insisted upon. Fifty-one such cases have appeared on our services in the ten years beginning January 1, 1926.

The analysis of this group of cases was undertaken with a fixed purpose as its goal, primarily to arrive at a better understanding of the agents influencing the progress of "morning sickness." Further, we have sought in the stories of these patients an absolute clinical indication or indications for the proper management of the disease. These findings are presented with sundry observations which may serve in the consideration and treatment of the patient with pernicious vomiting (chart 1).

INCIDENCE

"Morning sickness" occurs in at least 50 per cent of normal pregnancies, appearing usually between the sixth and eighth week of gestation and persists until the twelfth or fourteenth week and then disappears. In its period of persistence it consists only of nausea and vomiting in the morning on awakening. Rarely it may occur later in the day. Progressing into pernicious vomiting, there occurs gradual accentuation of symptomatology, vomiting occuring at all times independent of stomach content or feeding hours and is apparently uncontrollable.

Hyperemesis is a rare disease. Vomiting for which the patient seeks relief will occur once in 150 cases in private practice. In clinic practice it is seen once in 800 cases. Every case of pernicious vomiting has its roots in the innocuous "morning sickness."

ETIOLOGY

We have long ceased considering "morning sickness" and hyperemesis as manifestations of "toxemia." Whereas there exists but an hypothetical concept of the disease as of toxic origin, there is extant a mass of clinical and laboratory evidence demonstrating the metabolic dysfunction

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which underlies the syndrome. To properly present the evidence pointing to defective carbohydrate metabolism as the starting point of hyperemesis would mean complete review of the literature on the subject. It is sufficient to point out several fundamental facts.

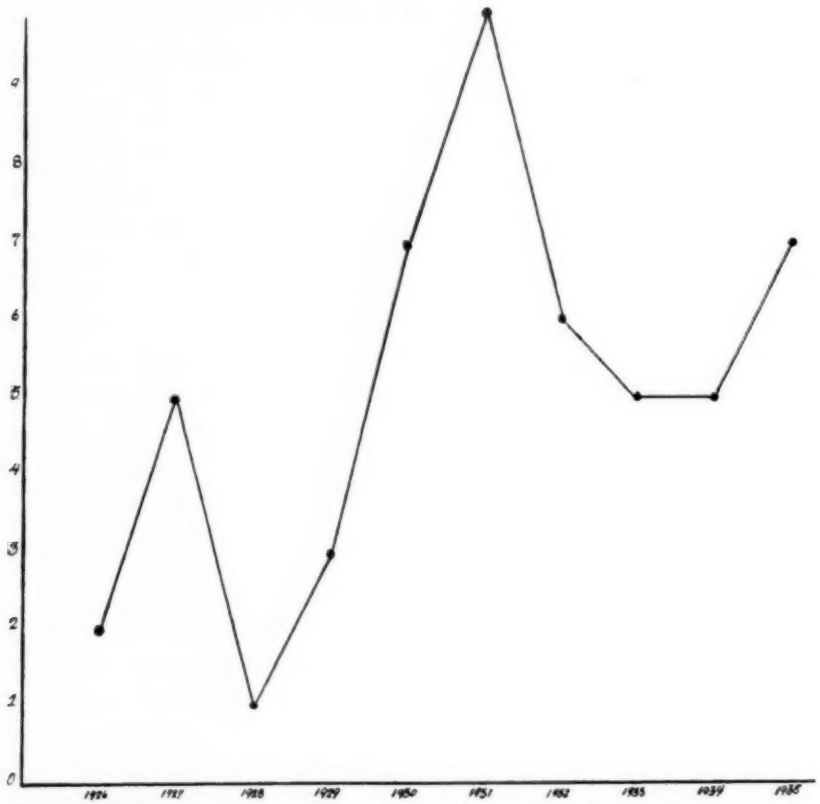


CHART 1. Distribution of 51 cases of pernicious vomiting of pregnancy over a ten year period. Note increase in annual total since 1929.

Stander has demonstrated that the fetus, in the early weeks of pregnancy, gains most of its nutrition from the carbohydrates of the mother. Novak and Porges have demonstrated the tendency toward ketonuria, a manifestation of defective carbohydrate metabolism, in pregnant women. Titus and Vogt have proved the role of glycogen deficiency, and Duncan and Harding have shown the value of high carbohydrate feeding. In the exhibition of carbohydrates there rests an excellent clinical and therapeutic test of the value of the theory of inefficient carbohydrate metabolism.

The starting point of the metabolic derangement is traceable to carbohydrate deprivation. The average normal diet of the woman before pregnancy cannot supply the carbohydrate requirements of the woman and the rapidly growing fetus. Deprivation of the mother by the fetus institutes an upset in the ketogenic-antiketogenic ratio. Clinically this is demonstrable in the prevention of "morning sickness" by high carbohydrate feedings immediately amenorrhea is reported. Similarly acetonuria may be prevented in the early months of gestation.

While we are satisfied that this theory explains the occurrence of "morning sickness," we are unable to account for the transition into hyperemesis. Since Williams' monograph in 1906 hyperemesis has been divided into three classes: (1) neurotic, (2) toxic, (3) reflex but we cannot subscribe to this classification. We have never seen reflex vomiting and no case in the present series has fit the original description. While we are familiar with the reported toxic vomiting, it has not appeared in this series

and these 50 cases have been derived from 24,000 obstetrical admissions. To all practical purposes, toxic vomiting is a rarity and probably in individual experience is very rarely seen.

With the neurotic classification of Williams we are in sympathy yet 25 per cent of our cases cannot be so listed. We are convinced from exhaustive study of case histories that *malingering* plays a powerful role in a goodly number of pernicious vomitors. This statement requires elucidation.

In the analysis of our histories in an attempt to seek the factors stimulating "morning sickness" we have had the assistance of one of the social service workers at The Harlem Hospital, who, for some time has been studying the economic and social background of many of the patients admitted to our service. From her we have learned that the terms "neurosis" and "hysteria" can never be made applicable to these patients as they are too burdened with responsibilities and the struggle for mere existence and subsistence. Unless one can conceive of a transient neurosis associated with pregnancy, or a hysteria originating concomitantly with early pregnancy, then these patients can never be regarded as neurotic pernicious vomitors.

Not only in the economically depressed patient does pernicious vomiting occur independent of neurotic origin, although the economic angle is important. We have seen a suggestive increase in cases since 1929. There are other factors which may stimulate emesis. The nulliparous woman bearing her first pregnancy may find many causes for pathomimesis, and tocophobia is of tremendous weight; the self-conscious patient offers numerous reasons; one example being the young, unmarried woman or the elderly patient finding herself pregnant with grown children surrounding her is another type; or the woman, recently delivered, who finds herself pregnant while still fatigued and convalescent from the first labor. In these patients who are seeking deliverance from the trials of childbearing and who turn to any means of escape, there is no neurosis unless their very rational thinking is to be stamped as neurotic. Hyperemesis is beyond their reach yet by virtue of accentuation of "morning sickness" these patients may carry themselves to a point of starvation and inanition where the vomiting escapes them and they need no longer malinger. They ultimately attain to pernicious vomiting despite themselves. In them we readily find the mechanism of altering the primary metabolic disorder into hyperemesis.

In the true neurotic patient the mechanism remains unknown, though there is no question but that there is present a great psychic element. Too many of these patients have been cured by suggestion, isolation and the like to doubt the psychic influence.

We consider pernicious vomiting from two points of view: (1) the neurotic patient

Table 1
CASES REQUIRING INTERRUPTION OF PREGNANCY

Onset of Nausea. (Days from Date of Last Menses)	Onset of Vomiting. (Days Following Onset of Nausea)	Duration of Vomiting before Intractability (in Days)	Duration of Intractability before Hospitalization (in Days)
39	18	42	4
44*	8*	11*	13*
Coincident with amenorrhoea		75	13
39*	3*	5*	Admitted on day intractability appeared.
58*	7*	39*	20*
Coincident with amenorrhoea		32	18
37	6	6	9
41*	8*	21*	21*
48	7	20	4
46	2	7	7
33	0	2	2
39	5	21	9
34	8	17	13
37	0	14	11
58	6	8	6
35	8	2	9
Average 36.7	6.1	20.1	9.9

* Indicates fatality.

in whom we have a history of personality defects or neurotic tendencies; and (2) the malingerer in whom self-induced starvation has escaped influence and has produced the picture of inanition and its accompanying emesis.

TABLE II
CASES MANAGED CONSERVATIVELY

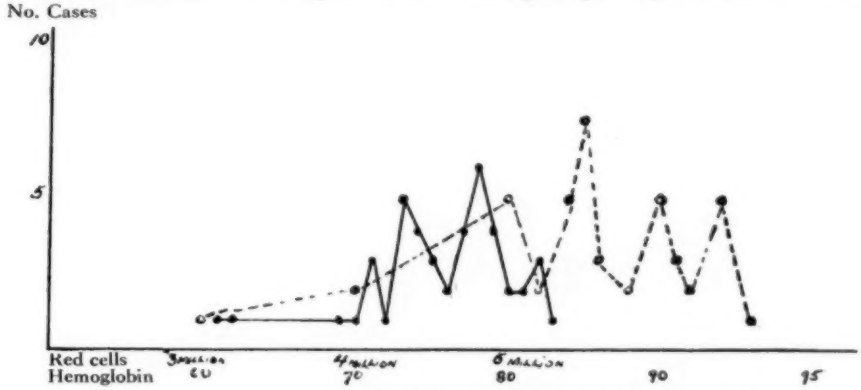
Onset of Nausea, (Days, from Date of Last Menses)	Onset of Vomiting. (Days, Following Onset of Nausea)	Duration of Vomiting before Intractability (Days)	Duration of Intractability before Hospitalization (Days)
36	0	30	7
41	8	24	10
35	37	10	10
33	18	14	0
46	10	30	10
55	7	57	..
180	..	19	1
55	5	41	7
30	8	10	10
32	4	20	21
48	17	11	11
39	3	18	18
35	15	12	4
53	22	49	6
41	12	4	22
38	9	16	17
38	6	55	35
33	0	55	0
41	5	11	6
38	5	28	10
38	26	10	2
33	55	2	24
41	0	24	5
56	12	14	7
35	4	9	0
32	5	3	2
34	6	11	10
37	8	10	4
33	9	6	6
31	8	7	10
50	12	39	12
59	5	8	11
38	4	6	4
	1 fatality under conservative management		
67	18	24	24

Laboratory Studies. While in the management of these cases the usual laboratory routines were followed we briefly consider them here. Urinalysis always revealed acetonuria and ketonuria. Further urinary studies were insignificant and non-productive. The blood chemistry findings duplicated previous work, moderately increased non-protein nitrogen and an occasional moderate decrease in blood chlorides, but we have never encountered the hypoglycemia, which Titus reports. We have never met with true acidosis, our findings agreeing with those of Dieckman and Crossen. We have never checked Van Wyck's findings, i.e., diminution in the serum protein and urobilinuria.

The blood counts of these cases presented a point of interest. Ordinarily there was a leucocytosis up to 12,000 white cells, with the increase chiefly in polymorphonuclear cells. The red cell counts and hemoglobin estimations showed evidence of blood concentration. The average red cell count in the patient admitted to our service approximates 4,000,000 cells with the average hemoglobin rarely above 80 per cent. From the following chart (11) it will be noted that in hyperemesis there is a tendency toward high red cell counts and high hemoglobin estimations. This blood concentration is common in conditions where there is a large and persistent fluid loss and is found in hyperemesis whether its origin is due to neurosis or malingering.

Clinical Considerations. History. The accompanying tables indicate the manner in which we have sought to check on the relationship of intractable vomiting to duration. The cases are divided into two groups: those ultimately requiring interruption of pregnancy and those cured by conservative therapy. It will be seen that there is no existing relationship between the duration of vomiting and the ultimate occurrence of intractability. Several notable facts are derived from these tables which must be mentioned. Of this group of 50 cases, only 4 sought medical assistance in early troublesome vomiting and, of these, none was successfully controlled. These patients were treated at home and the most potent therapeutic agents employed were corpus luteum and sedatives. Forty-six patients sought no treatment until vomiting became intractable and in

this group were several whose vomiting persisted three weeks and longer before hospitalization was effected. Study of the



Red blood cell count in hyperemesis
Hemoglobin determination (Sahli method)
The majority of cases are above 80 per cent.

Chart II.

tables will indicate that there exists no relationship between the duration of in-

Table III
RESPONSE TO THERAPY IN CASES REQUIRING INTERRUPTION OF PREGNANCY

Pulse		Blood Pressure		Diuresis	Ketosis (Urinary Acetone)
Before Therapy	After Therapy	Before Therapy	After Therapy		
140	140	110/65	94/68	None	Negative
120*	140	110/90	30/0	None	Positive
100	110	114/90	94/64	None	Positive
120*	120	122/80	84/40	None	Negative
120*	130	94/68	84/60	None	Positive
100	110	96/52	90/64	None	Positive
126	138	100/80	90/68	None	Positive
124*	134	90/48	80/0	None	Positive
132	132	92/80	94/66	None	Negative
122	120	100/60	90/78	None	Negative
118	118	100/54	92/50	None	Positive
140	140	86/48	88/48	None	Negative
110	120	100/90	94/66	None	Positive
80	100	110/60	128/70	None	Positive
104	130	106/70	106/70	None	Positive
120	160	90/60	88/46	None	Negative

* Indicates fatality.

tractability and fatal termination or between the duration of intractability and interruption of pregnancy.

The chief point is, that despite all the tremendous accentuation and publicity given to the advantages and desirability of prenatal care, in the vomiting of pregnancy, patients commonly avoid seeking assistance. We find, too, that in the rare exception that seeks advice, results are unsatisfactory.

Clinical Considerations. Physical Findings. Considering, for the sake of brevity, the group of 50 cases as a whole, certain findings on admission are of importance. In 49 the diagnosis of acetonuria was predicted from the odor of the breath. Every case, regardless of etiological classification, demonstrated dehydration by dryness of the tongue and mucosa. One patient was comatose on admission, one in acute mania and the rest were alert. Jaundice was present on admission in 7 cases, 2 of which terminated fatally. We have never seen jaundice develop in the course of hospitalization. Eleven patients vomited frank blood and in this group 3 fatalities occurred; one exhibited coffee-ground vomitus. Examination of the retina on admission or shortly thereafter revealed the presence of petechial hemorrhage in 5 cases. Four of the fatalities in the series were in this group.

In this group of cases the study of the occurrence of weight loss or emaciation has been of great interest. All these estimations have been approximate as we have had no means of an adequate check on the normal weight or the weight before pregnancy and the onset of disease. The graph (Chart III) indicates that there is a relationship between weight loss and ultimate case management. In 16 cases requiring interruption of pregnancy for cure of vomiting, the average weight loss was 13.6 pounds while in cases responding to conservative therapy the average weight loss was four pounds.

Only in 8 cases in a group of 34 treated successfully by conservative methods was the weight loss stated or evident. In addition to the story of the patient relevant to emaciation the patients were weighed on admission and during their hospital stay and clinical evidence of emaciation was sought.

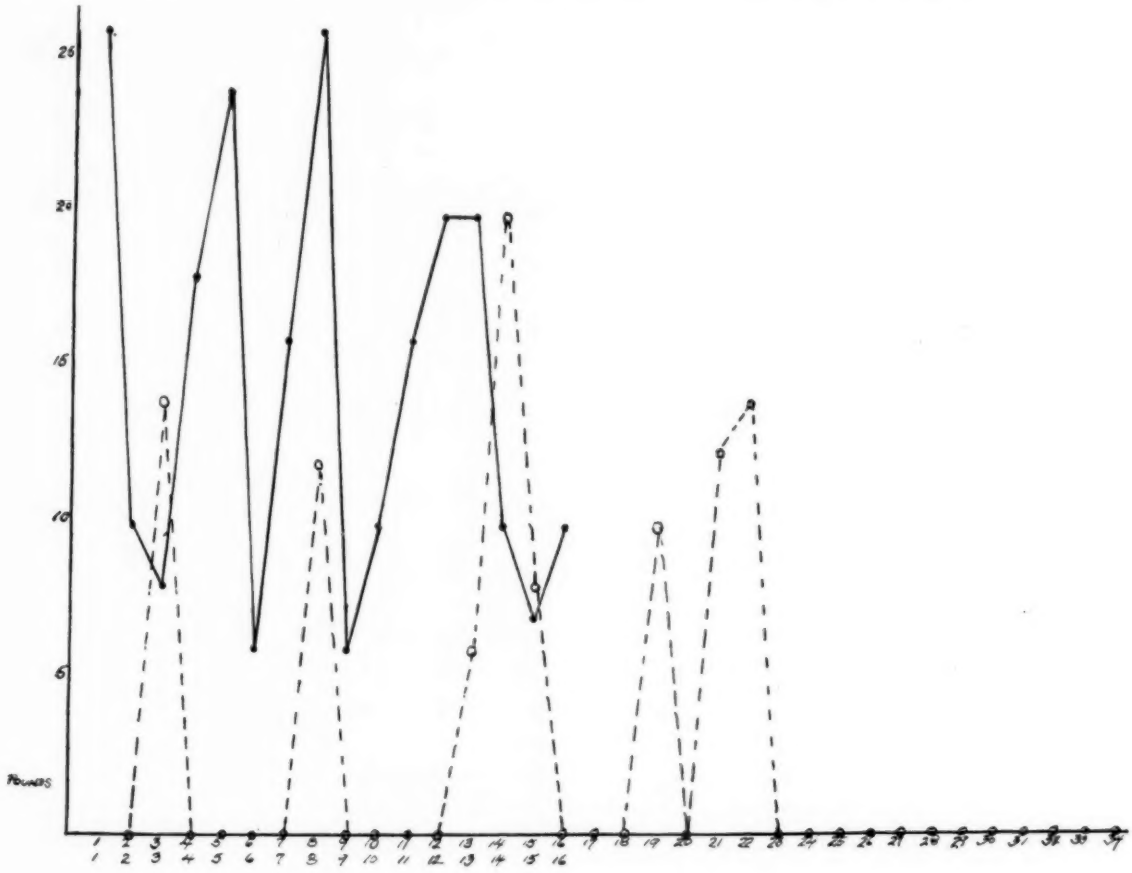


CHART III. Approximate weight loss in hyperemesis at time of admission.

	Pounds
Average weight loss in interrupted cases	13.6
Average weight loss in cases responding to conservative therapy	4

We are forced, by the findings in this group, to the conclusion that weight loss is a definite sign of loss of reserve and that where there is advanced emaciation or evident large weight loss, conservative therapy will probably fail of its desired result.

Therapy. It has been stated in the foregoing that but 4 cases of this group sought treatment for vomiting and that in each case therapeutic measures were unsuccessful. Despite the teachings and findings of numerous investigators, practitioners continue to treat pernicious vomiting in the patients' homes. It cannot be emphasized too strongly that the first step in the successful management of any vomiting of pregnancy beyond the simple "morning sickness" is isolation. Early hospitalization will reduce the incidence of pernicious vomiting to an easily disregarded figure.

Every case admitted to our service had reached intractability. Tables III and IV, covering the duration of vomiting, indicate this. Because we feared radical management and because we have seen miraculous results under psychotherapy we have turned from the dictum of Kosmak

and routinized the first forty-eight hours of management in these cases as follows:

1. On admission elicit history and make a complete physical examination, including vaginal.

2. Obtain a catheterized specimen of urine and whole blood and blood serum for laboratory and chemical examinations.

3. Isolate the patient and every six hours administer 1000 c.c. of 5 per cent glucose intravenously, *covering all the glucose with requisite insulin.*

Table IV
RESPONSE TO THERAPY IN CASES RESPONDING TO CONSERVATIVE MANAGEMENT

Pulse		Blood Pressure		Diuresis within Hours	Ketosis (Urinary Acetone)
Before Therapy	After Therapy	Before Therapy	After Therapy		
80	80	125/80	114/90	24	Negative
130	90	116/80	108/76	24	Negative
110	86	144/80	122/80	40	Negative
100	70	100/60	110/80	24	Negative
90	90	96/60	108/84	24	Negative
110	90	104/90	110/90	24	Negative
90	80	108/84	120/86	18	Negative
114	68	92/86	110/70	24	Negative
106	86	98/70	120/86	36	Negative
114	80	94/50	114/74	30	Negative
98	68	100/86	120/84	48	Negative
122	90	96/80	116/92	36	Negative
128	80	98/48	128/90	30	Negative
124	100	88/64	94/70	40	Negative
118	86	90/56	110/84	36	Negative
110	90	98/86	118/64	36	Negative
112	88	90/66	106/74	48	Negative
108	84	92/60	114/68	24	Negative
110	90	90/50	106/78	38	Negative
100	94	102/70	110/80	24	Negative
98	82	86/50	120/90	48	Negative
140	80	90/60	120/96	48	Negative
120	80	100/90	134/88	24	Negative
100	96	106/86	108/86	36	Negative
80	70	118/70	118/70	36	Negative
96	74	100/80	120/80	36	Negative
108	72	94/86	110/78	48	Negative
88	70	110/74	114/92	36	Negative
90	84	130/74	128/90	48	Negative
110	74	120/80	126/80	36	Negative
130	84	116/64	128/96	30	Negative
100	80	100/66	118/78	24	Negative
98	80	100/82	132/88	36	Negative
1 fatality under conservative management					
140	160–180	90/40	Not measurable	48	Positive

4. Administer per rectum 3 grams of sodium and potassium bromide and 1 gram of chloral hydrate in 100 c.c. of distilled water.

5. Never remove infusion apparatus from the room.

6. Permit no visitors.

7. Permit nothing by mouth, this includes mouth wash. All mouth hygiene is to be performed by the nurse.

In every case this routine of therapy is followed for forty-eight hours. There is no indication for interruption of pregnancy upon admission. Such procedure is open to criticism and in the face of experience is unnecessarily radical. Many patients under the outlined routine quickly improve. The fact that when improvement is to occur it manifests itself within forty-eight hours is notable, but if at the end of such a period of rigorous adherence to the plan, there is no evidence of improvement, pregnancy should be interrupted. To delay interruption if there is failure of improvement is to risk the life of the mother.

Three signs of improvement have been found, totally disregarding the symptomatic picture. (1) The chief sign of control is diuresis, (2) the pulse rate and (3) the blood pressure. We find Pinard's dictum to be untenable but the rate of pulse and the estimation of the blood pressure under therapy are of great importance. In the improving patient there is always a drop in pulse rate and a rise in blood pressure; antithetical findings occur where there is no improvement. The tables clearly indicate these facts, and further and more significant, it is to be noted that all these signs make their appearance within forty-eight hours of the onset of therapy. Another sign of importance which we have not tabulated is hunger. This subjective manifestation makes an early appearance with favorable response and we attach considerable importance to it.

Previous to the routine usage of insulin considerable weight was placed upon the disappearance of urinary acetone bodies under therapy. The use of insulin deprives us of this sign of advance yet, in contradistinction to Dieckman and Crossen, Harding and VanWyck, Campbell and Macleod, we concur with Thalhimer that relief and improvement are obtained more quickly with the routine administration of insulin. We feel that the sacrifice of the sign of

improvement is a fair exchange for the evident clinical advantage gained.

These conclusions have been drawn from a study of the response to therapy in this series of cases:

1. Response to therapy, if it is to occur, appears within forty-eight hours.
2. The chief indications of response are diuresis, slowing of the pulse and elevation of the blood pressure. The improving patient complains of hunger.
3. The clearing of urinary ketone bodies is not to be relied upon if insulin is employed in treatment.
4. When diuresis does not appear within forty-eight hours, the pulse rate increases and the blood pressure falls.
5. When these signs do not appear within forty-eight hours the immediate interruption of pregnancy is indicated.

INTERRUPTION OF PREGNANCY

When conservatism has failed, interruption of gestation carries a possibility of cure and when properly timed the results are invariably satisfactory. It must be recalled, however, that this disease has gained a firm foothold and that happy end results cannot always be expected. In this series of cases there were 5 deaths, a mortality of 10 per cent which should warn against prolonged delay of radical procedures.

The choice of procedure and anesthesia are important. The condition of the patient generally militates against any procedure which carries with it trauma or prolonged subjection to anesthesia. The method of emptying the uterus usually is related to the period of gestation; at eight weeks the curet is preferred, and between eight and fourteen weeks the placental forceps, in gestations beyond fourteen weeks vaginal hysterotomy is the method of choice. Regardless of the method of determining the procedure, it is sufficient merely to disturb the gestation with the least trauma and greatest speed. In the seriously ill patient the cervix is dilated and the curet is used until placental tissue is carried from the uterus or the membranes are ruptured. A strip of iodoform packing gauze is left in the fundus and supplemented by snug, vaginal packing will accomplish the completion of the abortion. It is illogical and unsurgical to submit these patients to hysterotomy or fundectomy. In this series 13 pregnancies were interrupted by dilatation and curettage; 2 were managed by the insertion of a bougie and fundectomy was performed once but this last patient had an exceedingly stormy postoperative course.

We have made it almost routine to transfuse these patients shortly before or during the operative procedure as their condition is so poor that their resistance to infection is practically nil and we do not permit them to undergo blood loss of any volume.

Careful choice of anesthesia is important. Since there must be no added burden, it is better that ether, chloroform and ethylene are avoided. Intravenous anesthetics, depending as they do upon normal hepatic function for their margins of safety, should not be used. The anesthetics of choice are spinal and nitrous oxide gas and oxygen. We used the latter 14 times and spinal in the remaining 2 cases.

Supplemental Therapy. To consider the battle won when the uterus is emptied or with improvement at the end of forty-eight hours of conservatism is to invite disaster. Fluids must be forced parenterally for at least seventy-two hours and preferably for ninety-six hours. When hunger has replaced nausea and vomiting as the chief complaint, feeding may be begun, but cautiously and gradually and should *not be started with liquids.* We begin feedings with teaspoonful rations of thick, dry cereals and never with more than one such dose per hour, later adding a banana mash in a similar dosage. The combination of thick cereal and bananas is continued for twenty-four hours before small amounts of fluid are added. These should never be cold nor should fruit juices or milk be used, warm water or tea being better tolerated. At the end of seventy-two hours of this regime a minimal light diet may be instituted and the normal diet gradually re-

stored over a period of ten days. Particularly in the conservatively successful case must this be followed, since relapses are prone to occur. This has happened twice in this series.

Necropsy Findings. Necropsy was obtained in only one of the 5 deaths in the series. The pathologist's report was of no great moment, the findings presented were characteristic of dehydration and starvation. The central necrosis in the hepatic lobules was not in evidence.

Significant Findings. This analysis proved a disappointment from the point of view of discovering clinical signs of infallible nature. We feel safe, however, in suggesting certain facts; in the presence of marked emaciation it may be the wiser procedure to proceed to interrupt the pregnancy without any trial at conservatism; hemorrhagic retinitis is a grave sign and there should be no dalliance with such cases. Where conservative treatment is instituted it should be allowed forty-eight hours to produce perceptible improvement.

CONCLUSIONS

A series of 50 cases of hyperemesis gravidarum is presented and analyzed.

The mortality for the series is 10 per cent, but the rarity of the disease is no justification for the mortality it carries.

Prenatal care has not yet reached to the earliest months of pregnancy and in consequence a controllable situation is escaping notice and is developing into a grave obstetric entity.

The patient must be educated to the fact that vomiting is dangerous and controllable and the practitioner must be urged to treat his cases in hospitals.

Radicalism immediately upon hospitalization is not justifiable but delay in interrupting the pregnancy should not be postponed beyond forty-eight hours of rigorous conservative therapy.

Pulse rate, blood pressure and diuresis are the best indicators of the effect of therapy. To disregard the warnings of the pulse rate and the blood pressure is only an invitation to disaster.

There is no absolute clinical guidepost to interruption of gestation.

Isolation and fluids are the chief agents in therapy.

The hospitalized patient is at the stage of intractability, best indicated by emaciation and by the concentration of the blood evident in red cell determinations and hemoglobin estimations.

The old classification of hyperemesis is no longer tenable and notice must be taken of the malingerer in whom there occurs an escape of pathology from voluntary control.

We must express an infinite gratitude to Miss H. Hotchkiss of the Social Service Department of The Harlem Hospital for her studies of the economic and social status of many of the cases here reported and for her fresh point of view on the role of neuroses in these women.

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HELPFUL DRUG IN TREATMENT OF TUBERCULOSIS OF URINARY BLADDER

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COPEMAN published an article in the *British Medical Journal* on the use of fluorescein activated by *x*-ray therapy, in cases of cancer. From this suggestion Gouldesborough[1] was led to instill two ounces of 5 per cent fluorescein into the tuberculous bladder of a patient and then use *x*-ray therapy. Walker[2] followed his technique in one case with some improvement of his patient.

Having under our care a single, white woman of forty-four years of age, who had the distressing bladder symptoms of frequency, nocturia and pain, with tubercle bacilli coming from both kidneys as proved by repeated positive guinea-pig tests, but only slightly abnormal pyelographic and functional findings, we explained the experimental nature of the treatment and she requested that it be instituted.

A 5 per cent solution was made by dissolving the acid fluorescein in water made alkaline by means of sodium bicarbonate. Two ounces were instilled into the bladder and roentgen ray therapy given. Although the incipient menopause was hurried to completion, she reported more relief than from any of the myriad of other treatments tried.

Subsequently two ounces of the alkaline fluorescein solution was instilled into bladder and left for half an hour but no roentgen ray therapy was used. Following this she reported nocturia once, and less pain and frequency during the day. Accordingly we were led to wonder whether or not the benefit was largely or possibly entirely due to the medication rather than to the roentgen rays acting in conjunction with the fluorescent chemical.

Experimentation with guinea-pigs showed that the acid fluorescein put into solution with sodium bicarbonate, was not only irritating to tissue but also destructive when injected subcutaneously, leading to slough and death. Accordingly we tried various fluorescein derivatives, determining that sodium fluorescein by mouth seemed non-toxic when given to guinea-pigs in large doses over a long time.

A twelve year old white female, whose father died of pulmonary tuberculosis and whose right kidney had been removed for tuberculosis, continued to have severe bladder symptoms, voiding every fifteen minutes during the day and so frequently at night that she obtained little rest, and even wet the bed repeatedly every night between trips to the toilet. Trial of the alkaline fluorescein solution was made. As roentgen therapy could not be used because of the destructive effect on the ovaries, we were delighted to hear that she considered herself benefited after each treatment. The instillations were painful, even when used following an instillation of a mucous membrane anesthetic agent, so we were led to try sodium fluorescein by mouth.

As this chemical was not available from apothecaries, it was obtained in bulk and two grain capsules filled. Starting cautiously the dose was gradually increased until the older woman took eight capsules daily and the girl six. Both reported great relief which became progressively more complete with the passing of time. The urine was definitely fluorescent, the intensity varying with the quantity of drug taken by mouth.

The girl showed no deleterious symptoms at any time, though she was not very faithful in taking medicine. After about nine months of treatment she said that she did not have any nocturia and did not

wet the bed. Cystoscopy eight months after the treatment had been started showed great improvement in the bladder, though the bas fond portion was still definitely involved. Urine of the apparently normal kidney and from the bladder was injected into guinea-pigs at this time. The pigs did not develop tuberculosis.

Cystoscopic examination of the woman performed eighteen months after treatment by instillation was started and ten months after treatment by mouth was started, showed a greatly improved bladder. The mucous membrane was nearly of normal color, did not bleed and was not unduly irritable. The left ureteral orifice appeared normal, the right orifice was slightly reddened. Urine from each kidney was clear and negative for tubercle bacilli, though a few pus cells were present. The right pelvis was slightly dilated with slight irregularity of one lower minor calyx and the left still showed a minor calyx at the upper pole which suggested irregularity. If there was any change, this minor calyx appeared more normal. If it represented a diseased area, it certainly had not progressed.

At this time, i.e., eighteen months after starting fluorescein therapy, she does not seem to be as completely relieved of the frequency as she was for the first year, though the bladder appears more normal than it ever has before.*

A guinea-pig was injected with her urine at the start of the treatment. After three weeks it showed definitely tubercular induration in the mammary region. Treatment of the pig with sodium fluorescein was instituted, approximately eight grains being given by mouth daily. This pig was pregnant and later gave birth to four young, two of which were dead and two feeble. Although caseation occurred in the mammary region, no ulcer developed, though some pus may have been discharged at some unknown time. The pig improved in weight and appearance. Six months after infection, it was apparently in fairly good health except for the large nodular area in the left mammary region. After seven months it again began to lose weight and died within two weeks of generalized tuberculosis.

A pig of similar size was injected with the woman's urine after she had been under this treatment for one month. Four weeks later it developed a nodule which progressed more slowly than that of the first pig. It failed progressively and died four months after injection, from generalized tuberculosis.

A pig was injected with the urine of the girl. This pig developed a nodule in the mammary region 1 cm. in diameter. The pig was given fluorescein. The nodule did not enlarge and the pig remained in fairly good health until seven months had passed when it died suddenly. Autopsy was not done because of failure to obtain message of pig's demise.

Two small pigs were injected with a known virulent tubercle bacillus (H 63 Saranac virulent human type), which had been innoculated into normal saline containing about the same amount of fluorescein as the urine of a patient receiving about ten grains daily of sodium fluorescein. This was estimated grossly by matching the colors. In the first case the germs were exposed to the fluorescein for twenty-four hours; in the second forty-eight hours.

A third large healthy pig was injected with the germs after exposure to the fluorescein for seven days.

The first two pigs died after the lapse of three and one-half months, one having been treated with sodium fluorescein and one not having been treated. The treated pig died two days before the untreated one. Both had generalized tuberculosis, proved at autopsy. The third pig developed

* Twenty-two months after fluorescein treatment was started, the woman who had bilateral renal tuberculosis developed more severe bladder discomfort. Pyelograms showed that the right kidney had become definitely tuberculous, while the left kidney seemed normal. The guinea-pig inoculated with urine from the left kidney was now negative though it had previously been positive repeatedly. The right kidney was removed. The patient is now practically well. Postoperatively she had a great deal of bladder pain, frequency and dysuria. Fluorescein instillations followed by a small dose of radiation, benefitted this greatly.

a small nodule about 7 mm. in diameter, after a month. This slowly disappeared and the pig remained in excellent health.

Recently, after nearly seven months this pig has developed an enlarged lymph gland on the side of infection. It does not have the consistency of a tuberculous node, and the pig is in good health.

Another large pig has been carried as a control, being given sodium fluorescein in large doses (10 to 20 grains daily by mouth) for eighteen months. It has remained in apparently perfect health. The medication is being continued in order to determine whether or not it will show any evidence of injury from long continued daily administration of sodium fluorescein.

A fourth pig was injected with 2 c.c. of the woman's urine after she had been treated with fluorescein for six months. A small induration developed in the muscles of the abdominal wall three weeks later. This diminished in size slowly until it disappeared.

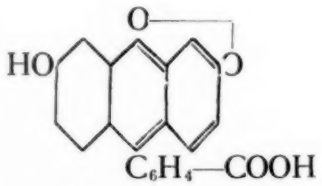
From the foregoing observations, it seems clear that sodium fluorescein when taken orally, gives some symptomatic relief to sufferers from tuberculosis of the bladder secondary to infection of the kidney. When an alkaline solution of fluorescein is used as an instillation in the tuberculous bladder, it gives symptomatic benefit. It seems possible sodium fluorescein has some slight bacteriostatic effect on the tubercle bacillus, though this is not enough to warrant much hope. This is supported by the clinical improvement of the 2 patients, which consisted of gains in weight in both, subsidence of afternoon temperature in one and the healing of a sinus in one; also by the fact that the pigs which were infected with urine from these patients and then treated with sodium fluorescein survived a longer time in apparent fair health than the untreated control. Of the 3 pigs injected with a known virulent human strain, the 2 pigs which were treated died without showing much capacity to localize the infection. The third, in which the organisms which were exposed to sodium fluorescein solution for seven days were injected, was untreated yet has survived apparently having healed an initial infection.

Benefit appears so promptly after commencing medication, that we are led to believe the fluorescein exerts a soothing action on the mucous membrane and possibly an antispasmodic on the sympathetic nervous system.

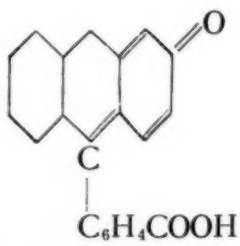
We realize that our inadequate facilities prevented the use of a large enough number of carefully controlled animals and patients to make this conclusive, but we do feel that the findings are interesting, suggestive and very helpful.

HISTORY AND PHARMACOLOGY

Fluorescein was first prepared by Baeyer in 1887 by fusing a mixture of phtalic anhydride and resorcinol. He gave the formula $C_{20}H_{12}O_5 + H_2O$ to the yellow product precipitated from alkaline solution by acids, while to the dark red powder crystallized from ethanol he gave the formula $C_{20}H_{12}O_5$.

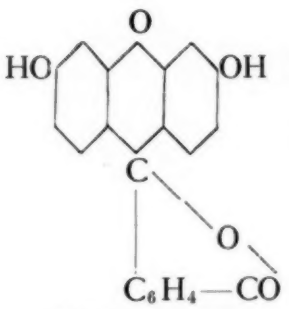


1. Fluorescein (o-quinoid).

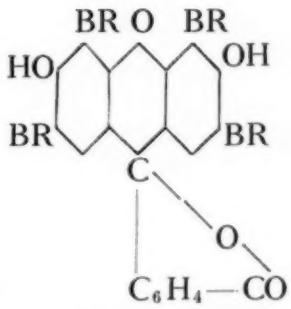


2. Fluorescein (p-quinoid).

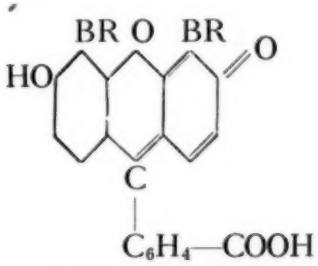
Investigations show that fluorescein exists in two forms, red and yellow, they being isomeric and having formula $C_{20}H_{12}O_5$. The yellow form is obtained by precipitating an alkaline solution of fluorescein with acetic acid at room temperature. The red form is obtained by precipitating a boiling, alkaline solution of fluorescein with acetic, formic or hydrochloric acid. It is believed that the yellow form of fluorescein, despite its color, has a lactoid structure (III) and that the red form has the P-quinoid structure (II).



3. Yellow Fluorescein (Lactoid).



4. Eosin (Lactoid).



5. Dibromo Fluorescein.

Fluorescein (resorcinolphthalein, dioxyfluorane, diresorcinolphthalein) is a red, crystalline powder, soluble in alkaline solution, at which time it is red by transmitted light. In weaker dilutions it has a bright green fluorescence. It is soluble in boiling dilute acids, alcohol, hot glacial acetic acid; it is insoluble in water, benzene, chloroform and ether. It is decomposed by heat above 290 degrees without melting. Employing a solution made from grain 7½ fluorescein, grain 15 sodium bicarbonate and one fluid ounce of water, it is used to aid in the detection of foreign bodies imbedded in the cornea, the diagnosis of corneal lesions and impervious strictures of the nasal duct. It is also used as an indicator and as a test for renal function, to determine actual death, and also, in the same ways as fluorescein.

LITERATURE

Strauss reported an investigation with sodium fluorescein used to estimate kidney function. Durand and Hugenin found that it still exhibited fluorescence when diluted 1:2,000,000. Ehrlich[6] introduced it into physiology in 1882, while studying the aqueous humor in animals. Hamburger[7] has reported that its amount in the aqueous humor of man is changed by the presence or absence of inflammation in the ciliary body. He gave doses of six to eight grams to adults and found no harmful after-effects, even when the dose was increased to fifteen grams. The only effect is a more or less yellowish coloring of the skin, which, with smaller doses disappears within eleven or twelve hours. In the larger doses the coloring disappears after twenty-four hours. The saliva and tears were colored green. The color of the urine was retained longer than that of the skin.

Strauss[5] gave fluorescein to 30 patients for kidney function tests. The fluorescence is equally visible in alkaline and acid reactions. No untoward accessory effects were seen. In patients with kidney disease, elimination was late in appearing and continued more or less past a forty hour period.

Hamburger[7] found subcutaneous injections painful. Guinea-pigs will tolerate a subcutaneous injection of sodium fluorescein in dilution but a dose of one gram causes a slight polyuria. One gram is a large dose for children.

In a case of carcinomatous peritonitis, a diffusion of the dye in the ascitic fluid was shown. It has also occurred in the ascitic fluid of dogs who have artificial nephritis.

In studies on the sources of the aqueous humor of the eye, Ehrlich[8] used ammonium fluorescein. When injected subcutaneously in concentrated doses it caused pain. The beautiful fluorescence enabled him to see the anterior chamber of the eye fill with aqueous humor in five to six minutes after the drug was administered to rabbits. He showed that a minute amount will cause fluorescence in the blood. He found no toxic or untoward effects in experiments with animals, although huge doses were used. It seemed probable that as Krosta suggested, in spite of the drug's apparent physiologic indifference, it had a slight definite mydriatic effect.

The possible mydriatic effect raises the question as to whether or not part of the beneficial effect we have noted in the bladder may be due to lessening spasm. We believe the effect is more profound than this and depends on the tendency of the fluorescein to localize in injured or diseased tissue and there exert an inhibitory effect on lower forms of life such as the tubercle bacilli.

In taking venous blood for chemistry, it was interesting to note that it was fluorescent enough to interfere with the mercury combining method of doing blood urea by the Hench and Aldrich method.

Raffo and Calcagno[9] found that while chlorine and iodine substitution products of fluorescein were hemolytic, the fluorescein itself was not and bromine products only slightly.

Tappeier and Raab[10] (1903) have found that fluorescent substances are very destructive to all forms of life, and also to ferments and toxins; but that the effects appear only in the presence of the specific light rays which induce the fluorescence. Toxins are very susceptible to fluorescence (Noguchi,[11] 1906).

The use of ultra-violet irradiation as an adjunct therapy may be of some benefit, but it is not necessary in order to obtain the symptomatic result.

CONCLUSION

Sodium fluorescein taken by mouth gives some symptomatic benefit to patients suffering from tuberculosis of the bladder secondary to tuberculosis elsewhere. It seems possible that it has some slight bacteriostatic effect on the tubercle bacillus.

I want to thank Dr. Leroy W. Gardner of the Saranac Laboratory for supplying me with the cultures of tubercle bacilli.

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FACTORS OF IMPORTANCE IN REDUCING

MORBIDITY AND MORTALITY FOLLOWING OPERATIONS ON BILIARY TRACT*

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PHILADELPHIA

A TREMENDOUS literature dealing with cholecystic disease in all its phases has developed during recent years, with many valuable and specific contributions being made by Judd, Mann, Graham and others. However, reports treating of methods and points of technique which are employed or developed in various clinics would seem to be of sufficient importance to warrant inclusion in the literature of gall-bladder disease.

A perplexing problem and one which always calls for nicety of judgment is the management of acute cholecystitis. Those surgeons who advocate immediate operation cite among the hazards of delay, complications such as perforation, peritonitis, extension of infection to the ducts and pancreas, pulmonary involvement and the overburdening of a damaged heart by toxemia. These are obviously manifestations of infection and their incidence is claimed to be reduced through immediate operation. Opposed to the practice of immediate surgical intervention are those surgeons who, from a wide experience, believe that the gall bladder rarely perforates into the general peritoneal cavity and that the ability of the gall bladder to overcome and localize infection has been underrated. Positive cultures have been obtained in approximately 75 per cent of our cases of subacute and chronic cholecystitis since we adopted the procedure of placing a piece of gall-bladder wall in a culture tube of glucose brain broth at the operating table (technique of Eiman[1]). Judd, Nickel and Wellbrock[2] have previously reported similar results. It has long been known that a gall bladder once infected remains so. An exception to this rule is the acute catarrhal gall bladder in which the submucosa has not been invaded.

If it were possible to get the average case of acute cholecystitis to the surgeon as promptly as, for example, the average case of acute appendicitis, the situation might be different, but very few surgeons actually see many early acute gall bladders. The practitioner does not send these cases to the surgeon at once, but treats them medically for several days. This may be our fault. At the Methodist Episcopal Hospital which cares for a large Italian population, gall-bladder disease is very common. Most of the cases seen have been ill for three or four days. Operation undertaken at this time certainly can not be termed "immediate" and it is questionable as to whether or not it can even be termed "early."

The complications which in our experience are most apt to occur following operation for acute cholecystitis and against which it is the surgeon's duty to fortify his patient, are failure of hepatic, renal and cardiac functions and hemorrhage; not perforation, peritonitis and their sequels. Adequate protection against these requires time, in some a shorter period than others. The question is not, "Can we get away with immediate operation?" but should we try to do so if by so doing we deprive the patient of the maximum protection to which he is entitled.

[1] EIMAN, JOHN. Personal Communication.

[2] JUDD, E. S., NICKEL, A. C. and WELLBROCK, W. L. A. The association of the liver in disease of the biliary tract. Collected papers of the Mayo Clinic and the Mayo Foundation. Phila., W. B. Saunders Co., 1930, pp. 84–90.

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Almost every surgeon of experience is able to point to brilliant results in cases where, on a diagnosis of some other acute abdominal condition, he has operated at once only to encounter an unsuspected acute gall bladder. It is true that these experiences make us pause and think, and doubtless it is this which has been responsible for the conversion of many surgeons to the practice of early attack. However, in many hospitals the majority of acute abdominal emergencies are operated upon by junior members of the surgical department. If we come to regard acute cholecystitis in the same category as acute appendicitis, strangulated hernia and other forms of acute intestinal obstruction, etc. the mortality is apt to be appalling.

It has been our practice to treat these patients with acute cholecystitis by placing them in the semi-Fowler position, washing out the stomach if vomiting is a prominent feature, withholding everything by mouth except small amounts of hot liquids, glucose by vein (1000 c.c. of 10 per cent per diem) and normal salt solution by hypodermoclysis. A small enema is usually given on admission and morphine is used rather liberally. If, under this plan, the patient shows continued improvement as to pain, fever, etc., he is allowed to go on improving and operation is deferred until fever has been absent for about a week, when cholecystectomy is done as the operation of choice. One reason for waiting in these cases is that cholecystectomy can be safely undertaken in patients who, operated upon during the height of their symptoms, could stand only cholecystostomy which is at best an unsatisfactory procedure, only to be done when the more formidable operation is unsafe. It is a compromise between adequate surgery and temporization. In the gall bladder that has become partially gangrenous and in which cholecystostomy obviously will not answer, Jopson practiced, what he termed subtotal cholecystectomy, with great success. The fundus of the gall bladder was amputated as far down as possible without extensive manipulation and a small tube sutured into the stump. This operation is not as shocking as complete removal of the gall bladder but is infinitely superior to simple drainage.

We do not infer by the foregoing statements that we never resort to immediate operation in acute gall-bladder disease. If seen at the onset and if there is no obvious contraindication, or if the case seen later does not show improvement under the waiting plan, particularly with increasing pain and tenderness, operation is done at once. In these patients our results from the point of mortality and morbidity have been gratifying.

The surgeon must have adequate and responsible advice from the internist on many phases of cholecystic disease. The diagnosis, presence of complicating lesions of the heart, lungs, kidneys or diabetes, and the manner in which they will or will not adversely affect the subject of a proposed gall-bladder exploration are duties of the medical man to appraise and inform the surgeon. The decision to operate must remain in the province of the surgeon for it is his responsibility and his alone.

The addition of intravenous glucose to the pre- and postoperative management of gall-bladder cases has been of incalculable value. Where an elective operation is to be done our patients are given 500 c.c. of orange juice to which are added 50 grams of sugar during each twenty-four hours, unless the stomach will not tolerate it. This we have found to be a very efficient means of increasing the glycogen reserve. In addition glucose is given intravenously in amounts of 500 to 1000 c.c. of 5 per cent solution either in distilled water or normal saline depending upon the blood chloride content. Since we have followed this plan the postoperative morbidity, particularly as regards vomiting, has been greatly reduced. In a group of 272 postoperative gall-bladder patients, allowing one emesis during recovery from anesthesia, those individuals who had been so prepared showed an incidence of vomiting of 3.5 per

cent. In another group of this series not receiving glucose 52 per cent vomited two or more times and a few suffered persistent vomiting for short periods. The application of the suction drainage of Wangensteen, withholding fluids by mouth, and postoperative intravenous glucose and saline usually give prompt relief from this complication. A safe rule is to allow these patients nothing by mouth for the first twenty-four hours.

Surgical technique presents an opportunity for a discussion of certain procedures which in our opinion are helpful in promoting a smooth convalescence. Adequate incisions of the Bevan or Mayo-Robson type allow a good exposure of the structures of the biliary system. There is no question of the value of ample room against cramped space associated with strong retraction of the abdominal walls for lowering postoperative morbidity. The surgeon knows that wounds heal from the sides and not from the ends. The appendix should be examined and if its removal is indicated no attempt should be made to deliver the cecum through the original incision if this presents any difficulty. It is much better to make a small gridiron incision immediately over the cecum. Other things being equal, rapidity of operation is an important factor. This, together with better control of the cystic artery and duct, is facilitated by adequate incision. Disaster in the form of hemorrhage, injury to the common duct and trauma to other tissues has crept in through many a "button-hole" type of incision.

Once the incision has been made the packing off becomes important and it is remarkable that many surgeons perform this step in a most casual or haphazard manner. Two or three large packs are necessary; one carries the stomach and duodenum to the left, a second displaces the colon downwards and a third may be necessary to prevent loops of small bowel from intruding. Packing off in this manner permits of easy access to the gall bladder and ducts without recourse to strong retraction. We prefer the large gooseneck retractor of the Deaver type for this part of the operation.

Individual isolation of the cystic duct and cystic artery have much to do with proper ligation of each of these structures. Each is isolated, clamped, cut and ligated. A useful maneuver is for the first assistant to support the clamp and with a long finger forceps with the first knot loosely tied, carry the ligature over the end of the clamp. The surgeon tightens the knot and the assistant, when directed, removes the clamp. A second and third knot may be applied by the operator. With this technique we have rarely been bothered by hemorrhage incident to removing the clamp.

When the common duct requires exploration and drainage an "L" catheter is sutured in place for periods up to three weeks; for longer periods the T-tube is preferred. We agree with Judd[2] that if the common duct requires opening it should not be closed primarily. Prolonged drainage has a very beneficial effect upon the congested liver and upon chronic pancreatitis. This type of drainage may be maintained for weeks or even months. We have frequently allowed a T-tube to remain for six months and one patient wore a tube for four years.

Regarding drainage we believe that a drain should always be inserted and that contrary to the experience of others, hernia is unlikely, especially when the drains are brought out through a lateral stab wound. The patient is spared the complications following slipping or premature absorption of a ligature, or leakage of bile from an unnoticed accessory duct. Prolonged drainage is unnecessary. We usually employ only a small drain of the Penrose type which is loosened on the fourth day, removal being completed on the sixth or seventh day. If there has

[2] Judd, E. S., Nickel, A. C. and Wellbrock, W. L. A. The association of the liver in disease of the biliary tract. Collected papers of the Mayo Clinic and the Mayo Foundation. Phila., W. B. Saunders Co., 1930, pp. 84–90.

been much bleeding an additional small rubber tube is placed in the subhepatic space. In this case the Penrose drain is removed in forty-eight hours and the tube shortened one inch a day beginning on the fifth day.

Save in a few cases of acute cholecystitis or the acutely ill or very old patient with chronic cholecystitis, cholecystectomy has been the procedure in all cases. The stoneless gall bladder which causes indefinite symptoms and which concentrates dye well should receive medical management. However, the stoneless gall bladder which gives rise to dyspepsia of the biliary type had best be removed if the patient is to be cured. Cholecystography in these cases is not a completely reliable guide. Often these organs are the seat of cholesterosis and will show function superior to the normal organ but they cannot be considered free of disease.

In all matters pertaining to the management of gall-bladder disease judgment is the essential factor. It is a product of experience which should be able to guide the surgeon in arriving at that decision which will best serve the interests of the patient.

TILTING the patient one way or another, according to whether the surgeon thought he wanted rapid or slow absorption, led to the adoption of a number of postures in pathologic conditions. Happily, all these now remain only as examples of the fallacy of basing our practices on logic instead of clinical observations. As a matter of fact, the peritoneum is of the same structure in all its parts; and absorption, other things being equal, goes on throughout it with equal rapidity.

Surgical Pathology of the Peritoneum by Arthur E. Hertzler, M.D.

CHRONIC PAINFUL CONDITIONS AMENABLE TO RELIEF BY INTRASPINAL (SUBARACHNOID) INJECTION OF ALCOHOL*

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SINCE 1931, there has been an increasing interest in the use of alcohol intraspinally.[1–23]

Where pathological lesions causing severe pain cannot be corrected by proper surgical or medical means, the profession has had to resort to the liberal use of narcotics, or to open operative procedures on the peripheral, sympathetic or central nervous systems. With the development of a method of controlling severe intractable pain by segmental analgesia of a more or less permanent nature, chordotomy, posterior rhizotomy, peripheral nerve sectioning and sympathectomies may become unnecessary in most cases.

Pain caused by any peripheral irritation of somatic or sympathetic nerves may be relieved by the intraspinal injection of alcohol. Pain caused by nerve root irritation may also be relieved by this method.

The following list of causes of chronic painful conditions gives one some idea of the scope and possibilities of segmental permanent analgesia. While the method is a relatively simple, safe, painless and nonshocking procedure, it may cause unpleasant complications if used improperly, or by one not thoroughly acquainted with the details of neuroanatomy and all the principles of the technique. As with other new techniques, reports will inevitably appear on the complications following the use of alcohol intraspinally.[22,23] These complications should be unnecessary, and are bound to follow slight deviations in technique or changes in dosages from those recommended. I have repeatedly stressed the possible complications. This subject is fully covered in my most recent article.[24]

In compiling this list, it is assumed that the usual medical and surgical treatments have been of no avail, or that operations for surgical conditions are contraindicated. Many of the so-called "hopelessly incurable cases" having severe intractable pain may now get relief by this method.

CAUSES OF CHRONIC INTRACTABLE PAIN

I. In the Shoulder
   1. Aneurysm
   2. Angina
   3. Aortic regurgitation
   4. Chronic Arthritis
   5. Cancer of the liver
   6. Chronic diaphragmatic pleurisy
   7. Chronic duodenal ulcer
   8. Carcinoma of duodenum
   9. Carcinoma of gall bladder
   10. Chronic gastric ulcer
   11. Carcinoma of stomach
   12. Herpes zoster
   13. Chronic phthisis
   14. Chronic pleurisy
   15. Chronic subacromial bursitis

II. In the Arm
   1. Adiposis dolorosa
   2. Aneurysm
   3. Brachial neuralgia, neuritis, plexus lesion
   4. Atheroma
   5. Cardiac causes
   6. Cervical caries
   7. Cervical rib
   8. Cystic diseases of breast

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9. Growth in vertebra
10. Herpes zoster
11. Intravertebral tumor
12. Left arm—angina pectoris, aortic regurgitation
13. Right arm—angina pectoris, carcinoma of liver, heart diseases
14. Mediastinal growth
15. Occupational neurosis
16. Psychalgia
17. Radicular or root lesions
18. Syphilis of aorta

III. In the Upper Extremity

(a) Brachial Neuralgia
1. Rheumatic or gouty diathesis
2. Malaria
3. Chronic alcoholism
4. Diabetes
5. Cervical rib

(b) Brachial Neuritis
1. Alcoholism
2. Lead, arsenic
3. Cervical rib or fibrous cord
4. Tumor in posterior triangle of neck
5. Glands in axilla
6. Aneurysm subclavian artery
7. Malignancy cervical vertebras
8. Caries of cervical vertebras
9. Spinal cord tumor
10. Spinal gliosis
11. Neuromata or fibroneuromata
12. Adiposis dolorsa

(c) Radicular Pain
1. Intravertebral tumor
2. Pachymeningitis
3. Cervical caries
4. Malignant disease of cervical vertebras
5. Herpes zoster
6. Inflammatory or vascular disease in region of posterior root ganglia

IV. In the Breast
1. Cancer
2. Cystic disease
3. Epithelioma of nipple
4. Heart disease
5. Mastodynia with painful menstruation
6. Pleurisy

V. In the Chest
1. Adiposis dolorosa
2. Aneurysm
3. Aortitis, or mesaortitis
4. Angina pectoris
5. Bronchiectasis
6. Chronic bronchitis
7. Cardiac—initial pain over Cervical 2
Auricle—Thoracic 5–8
Ventricle—Thoracic 2–5
Ascending aorta—Cervical 3, 4
Descending aorta—Thoracic 1–3
Chronic pericarditis
8. Tumor of ribs
9. Disease of spine
10. Emphysema
11. Fracture of spine
12. Gastric ulcer
13. Heart burn—from regurgitation into esophagus of gastric contents—Thoracic 5
14. Herpes zoster
15. Intercostal myositis
16. Intercostal neuralgia
17. Mediastinal growth
18. Myalgia
19. Esophageal obstruction
20. Pleural adhesions; pleurodynia
21. Pulmonary tuberculosis
22. Slipping rib
23. Spasm of esophagus
24. Spinal caries
25. Spinal cord lesions
26. Spondylitis deformans
27. Tabes dorsalis

VI. In the Abdomen
1. Actinomycosis of spine
2. Chronic pancreatitis
3. Chronic peritonitis
4. Postoperative adhesions
5. Chronic pleurisy associated with tuberculosis or neoplasm
6. Aneurysm
7. Angina abdominalis

8. Atheroma
9. Lead colic
10. Duodenal ulcer
11. Chronic dysentery
12. Epithelioma of esophagus
13. Old fracture of spine
14. Gastric ulcer
15. Gastric crises
16. Gumma of spine
17. Hypertonus of colon
18. Chronic infective osteoarthritis of spine, spondylitis deformans
19. Mediastinal growth
20. Morphia
21. Myocardial degeneration
22. Neoplasm of spine
23. Caries of spine
24. Perisplenitis, Pick's Disease
25. Chronic salpingitis
26. Spastic constipation
27. Chronic tuberculosis of colon
28. Chronic tuberculosis of glands
29. Chronic tuberculous peritonitis
30. Ulcerative colitis

VII. In the Epigastrium, in addition to conditions enumerated in VI
1. Carcinoma of liver
2. Hyperchlorhydria
3. Intercostal neuralgia
4. Mitral disease
5. Neoplasm of pancreas
6. Pancreatic calculi
7. Chronic passive congestion of liver
8. Perigastric adhesions
9. Chronic pleurisy
10. Plumbism

VIII. In the Hypogastrium
1. Severe cystitis
2. Duodenal ulcer
3. Gastric ulcer
4. Liver lesions

IX. In the Hypochondrium
1. Carcinoma of gall bladder
2. Carcinoma of colon
3. Gastric carcinoma
4. Herpes zoster
5. Intercostal neuralgia
6. Perisplenitis
7. Chronic pleurisy

X. In the Iliac Fossa
1. Aneurysm of iliac artery
2. Carcinoma of cecum
3. Herpes zoster
4. Chronic pleurisy
5. Spinal lesions
6. Tuberculosis of cecum
7. Tuberculous kidney
8. Tumor of iliac bone

XI. In the Back
1. Abdominal aneurysm
2. Aortic regurgitation
3. Carcinoma of bladder
4. Carcinoma of spine
5. Catamenia
6. Duodenal ulcer
7. Chronic dyspepsia
8. Chronic endometritis
9. Carcinoma of gall bladder
10. Gastric ulcer
11. Neoplasm of meninges
12. Herpes zoster
13. Impacted pelvic tumor
14. Traumatic injuries to back; especially important in compensation cases
15. Railway spine
16. Lateral curvature
17. Lumbago
18. Malaria
19. Osteoarthritis of spine
20. Carcinoma of ovaries
21. Chronic parametritis
22. Carcinoma of rectum
23. "Rheumatism"
24. Rheumatoid arthritis of spine
25. Spinal caries
26. Tumor of spinal cord
27. Carcinoma of uterus
28. Carcinoma of seminal vesicles

XII. In Kidney Region
1. Carcinoma of kidney
2. Pyelonephritis

XIII. In the Penis
1. Carcinoma of bladder (base); pain of carcinoma of ureteral orifice is referred to kidney region
2. Carcinoma of rectum
3. Cystitis
4. Gout

5. Herpes zoster
6. Papilloma of bladder
7. Piles
8. Prostatic abscess, hypertrophy, calculus
9. Rectal fissure
10. Trigonal lesions
11. Tuberculosis of kidney, ureter, bladder
12. Diseases of seminal vesicles

XIV. On Micturition
1. Carcinoma of urethra
2. Carcinoma of bladder
3. Carcinoma invading bladder
4. Cystitis
5. Carcinoma of prostate gland
6. Chronic prostatitis
7. Ulceration of bladder

XV. In the Testicle
1. Neoplasm
2. Tuberculosis
3. Epididymo-orchitis

XVI. Spasmodic Pelvic Pain
1. Lesions of uterus

XVII. In Ovarian Region
1. Carcinoma of ovaries
2. Carcinoma of uterus
3. Carcinoma of tubes
4. Carcinoma of kidney, ureter
5. Carcinoma of gall bladder
6. Carcinoma involving intestines
7. "Hysteria"

XVIII. Bearing Down Pains
1. Carcinoma of rectum
2. Endometritis
3. Fibroid uterus
4. Hemorrhoids
5. Ovarian tumor
6. Retroversion of uterus

XIX. Referred Pain to Lower Extremity from Visceral Disease
1. Disease of rectum
2. Disease of bladder
3. Disease of prostate gland
4. Disease of uterus

XX. In the Lower Extremity
(a) Pains of a Neuritic or Neuralgic Origin
1. Sciatica—in pelvic inflammation, tumor, retroverted uterus, disease of hip joint, tuberculosis, syphilis, lumbosacral malignancy
2. Anterior crural neuralgia or anterior cruritis
3. Obturator neuralgia
4. Meralgia paraesthetica (external cutaneous nerve of thigh)
5. Metatarsal neuralgia
6. Calcaneodynia
7. Multiple neuritis
8. Tabes dorsalis
9. Acroparaesthesia

XXI. With Disturbances of Circulation of Lower Extremity
1. Intermittent claudication
2. Raynaud's Disease
3. Erythromelalgia
4. Thrombo-angiitis obliterans, Buerger's Disease

XXII. General Pains in the Limbs.
1. Meige's Disease (angioneurotic edema)
2. Weil's Disease
3. Tropical congestion
4. Leprosy-painful stage

XXIII. Other Conditions Causing Chronic Pain Which May Be Relieved by Intraspinal Alcohol Injections
1. Acroparaesthesia
2. Pruritis ani
3. Pruritis vulvae
4. Chronic leg ulcerations
5. Scleroderma
6. Sympathetonia
7. For postoperative pain—injection to be given preoperatively as before prostatic removal, amputation, extensive plastic operation, etc.
8. Painful stumps—causalgia.
9. Chronic spastic contractions and tremors, dystonia musculorum deformans, Little's Disease, etc.

SUMMARY

1. The intraspinal (subarachnoid) injection of alcohol for the relief of intractable

pains has been reported to be of value by an increasing number of observers.

2. To emphasize the value and scope of this method of relieving pain, a list of chronic painful conditions amenable to this treatment has been compiled.

3. Complications following the use of alcohol intraspinally can only be avoided by strict adherence to the proper technique. Any occasional and scattered reports of untoward effects should not detract from this invaluable method of relieving pain.

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CASE REPORTS

TRAUMATIC INJURY OF ABDOMEN WITH EXTENSIVE DAMAGE TO COLON AND SMALL BOWEL

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ON August 25, 1933, at 11:30 A.M., H. R., a white male, aged ten years, was riding on his bicycle. An automobile going in the opposite direction struck him with such force that the handle of the door punctured his left abdomen and jerked out his stomach and intestines. He was thrown several feet into the air, landing on his back on a carline parkway of grass and chert, remaining in this position about thirty minutes until the ambulance arrived. When he was placed on the stretcher a section of the bowel dragging on the ground was picked up and placed on the stretcher. When he reached the emergency room of the hospital he was in shock but conscious. Examination revealed a wide, gapping, jagged, penetrating wound of the abdomen in the mid-epigastrium, 2 cm. to the left of the median line. The wound extended outward and downward below the costal margin ending in the left lower kidney fossa, with evisceration of the contents of this section of the abdomen which included the omentum, the greater portion of the small bowel, the lower portion of the stomach, exposing the spleen and stripping the muscles from the eighth and ninth ribs in the midclavicular line. The serosal and muscular coats of the colon were stripped from the mucosal tube, leaving this bare from the middle of the transverse colon to the sigmoid, at which point it was torn entirely across its lumen. The eviscerated parts were covered with blood, sand, rock and grass. The small bowel also had a rent in the jejunum 4 inches from the ligament of Treitz, which involved three-fourths of the circumference of the bowel on its anti-mesenteric border (Fig. 1).

To combat the shock 500 c.c. of 6 per cent acacia were given intravenously. Immediately under ether anesthesia, the abdomen and all exposed viscera were cleansed thoroughly with green soap and water. The rent in the jejunum was closed. The denuded tube was excised at the midportion of the transverse colon and the transverse colon was approximated to the sigmoid with end to end anastomosis. The bed of the colon, from the mid-transverse colon to the sigmoid, which was robbed of its mucous tube was left intact and the raw edges were approximated with catgut. Since we realized the chances for leakage from the colon on account of the trauma and its new position, a colostomy was made 2 cm. proximal to the anastomosis, suspending the colon extraperitoneally over a glass rod. The exposed viscera was returned to the cavity. The lacerated, jagged, abdominal wound was closed in layers, using interrupted sutures, and drainage was provided through the lateral and posterior lumbar region. Following the operation the abdominal wound was supported with multiple adhesive strips which were applied to the skin. These extended well away from the injured parts in a criss-cross manner (Fig. 2).

TABLE 1

FLUID INTAKE BY CONTINUOUS INTRAVENOUS DRIP AND URINE OUTPUT FOR 5½ DAYS

	Fluid Intake, c.c.	Urine Output, c.c.
Aug. 27	8400	4384
Aug. 28	7250	4448
Aug. 29	5300	2624*
Aug. 30	7150	5248
Aug. 31	5750	4800
Sept. 1	1850 (first 12 hrs.)	2368†

* Remainder of urine output could not be measured. voiding involuntary.

† Intravenous drip discontinued.

The outstanding conditions which had to be combatted following the injury were peritonitis, high intestinal fistula and reconstruction of the colon and the closure of the colostomy.

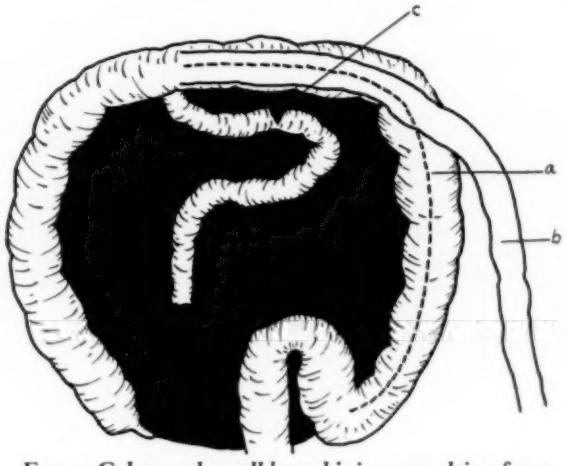

Fig. 1. Colon and small bowel injury resulting from accident; *a*, split in the serous and muscular coats of colon extending from the proximal transverse colon to sigmoid; *b*, denuded mucous barrel of colon stripped of its muscular and serous coats from the proximal transverse colon to sigmoid; *c*, rent in jejunum 4 inches from ligament of Treitz.

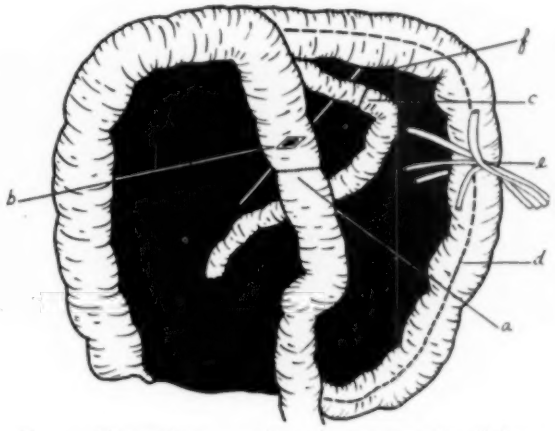

Fig. 2. Operation; *a*, point of anastomosis of sigmoid to the proximal transverse colon; *b*, colostomy 2 inches proximal to the point of anastomosis of the two colon loops; *c*, closed rent in jejunum; *d*, split through the serous and muscular coats of colon extending from proximal transverse colon to sigmoid; *e*, rubber tissue drains placed above and beneath the bed of the injured descending colon through the lateral and lumbar space; *f*, glass rod placed extraperitoneally beneath the colon at the point of anastomosis.

Peritonitis. During the first six days to relieve the peritoneal infection the following agents were employed: decompression of the stomach with nasal tube, multiple blood transfusions, and the giving of saline and glucose by continuous intravenous drip (Matas method[1]) (Table 1 and Fig. 3). On the ninth postoperative day, an intestinal fistula occurred high in the jejunum. We were not sure whether it was at the point of injury or in close proximity to the severed portion. However we did not see any linen sutures, nor did the bowel mucosa show evidence of the old injury.

Following the peritonitis, the loss of body fluids through the jejunal fistula was great and for the next thirty days in order to maintain the fluid level, 2000 c.c. or more of glucose and saline were given daily. Whenever this was omitted for twenty-four to thirty-six hours, he would develop certain characteristic symptoms, i.e., weakness, drowsiness and evidence of dehydration, and at times vomiting. The blood chemistry would show a marked rise in non-protein nitrogen and urea nitrogen. When the intestinal drainage was the most free, the urinary output often dropped to 4 or 6 ounces each twenty-four hours. On one occasion only 30 c.c. of urine was collected during twenty-four hours, and this was by catheter.

The prognosis of the intestinal fistula is based on its location. "Everything being equal, the further the fistula is from the duodenum and the first twelve inches of jejunum, the better the prognosis," is Ochsner's[2] theory. Colp[3] collected a series of 61 cases of duodenal fistula and there was a mortality of 51 per cent. In the small bowel fistulas, occurring within this region, unless some attempt is made to prevent the digestive action of the discharge, the wound will almost invariably enlarge with rapid loss of fluids, loss of electrolytes, and starvation of the patient. To combat these symptoms and signs certain things are necessary: to prevent the intestinal discharge from coming in contact with the abdominal wall, especially the skin, and to supply substances which are lost to the body through the fistulous communication.

Among the agents tried in this case were, packing the fistula with gauze and keeping it moist with beef broth and acetic acid dressings

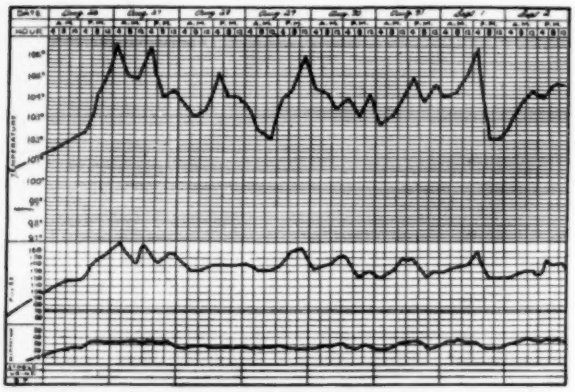

Fig. 3. Temperature, pulse and respiration rates for the first eight days.

to the skin margins. Also Fuller's earth made into a paste with olive oil was used. These measures were not applicable however in this case, because of the extensive infection of the abdominal wound which permitted a retraction of the abdominal wall and a herniation of the bowel. We found better results were obtained with a water suction apparatus, when the catheter was introduced well into the proximal loop of the fistulous bowel. The suction treatment was continued for seventeen days, and heat was also applied to the injured area in the form of a coop light. The result was the closure of the wound by granulation. The patient was confined to the hospital for two and one-half months.

When he returned home, the abdominal wound had closed with firm cicatrix, and the mucous membrane of the small bowel was firmly adherent to the skin. During the next six months the fistula was treated with beef broth applications and dressings of acetic acid. He was permitted to engage in gradual exercise. To replace the loss of body weight a high carbohydrate and protein diet was given.

He returned to the hospital on July 22, 1934, approximately eleven months following the accident, for the repair of the small bowel fistula. Surgical experience has taught us that closure in small bowel fistula in the acute stage is most apt to meet with failure due to pathological processes in the gut wall. Also within a few days the sutures will pull out and leave a larger opening than before surgery was instituted. But in this case after an elapse of one year following the injury, the wound had healed with a firm cicatrix, and the mucous membrane of the bowel had grown to the skin.

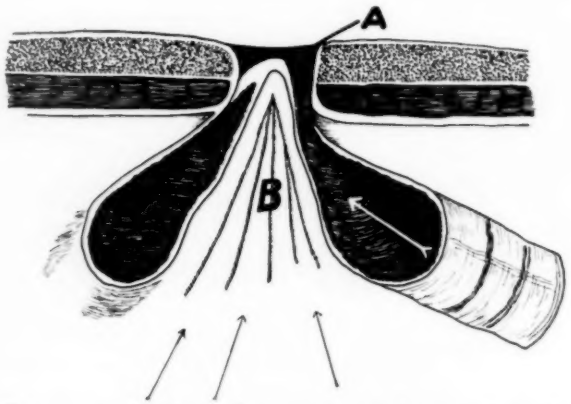

Fig. 4. A, fixation of mucous membrane of small bowel to skin; B, herniation of the mesenteric portion of small bowel.

Therefore surgery was essential (Fig. 4). On July 23, under ether anesthesia, the bowel was separated from the skin wall down to the peritoneum, and the rent in the bowel was closed in a transverse direction, using two rows of sutures, reinforced with interrupted linen sutures with rubber tissue drainage extending down to the fascia. On the fifth postoperative day the bowel began to drain with the return of the fistula. Some prosthetic appliance now seemed indicated. A T shaped tube, as recommended by Kappis,[4] was placed in the bowel (Fig. 5). The horizontal limb of this tube was three times larger than the vertical limb, and of sufficient weight to overcome the herniation of the mesenteric portion of the bowel. The size and weight of the tube permitted the fecal current to flow along the bowel lumen instead of to the fistulous opening. The tube remained in place for twelve days. By this time the fistulous sinus had contracted with active granulations. Therefore the tube was removed and there was an early closure of the skin wound.

Reconstruction of the Colon and Closure of Colostomy. No attention was given to the large bowel and to the colostomy until the small bowel fistula was closed firmly except when impaction occurred. Then mild laxatives and saline enemas were used. Meanwhile the distal barrel of the colon became incorporated in a mass of adhesion, producing a blind pouch at the point of the anastomosis. This pathological change was the result of cicatrical tissue

from the extensive infection of the abdominal wall, peritonitis, and to a less degree disuse (Fig. 6A).

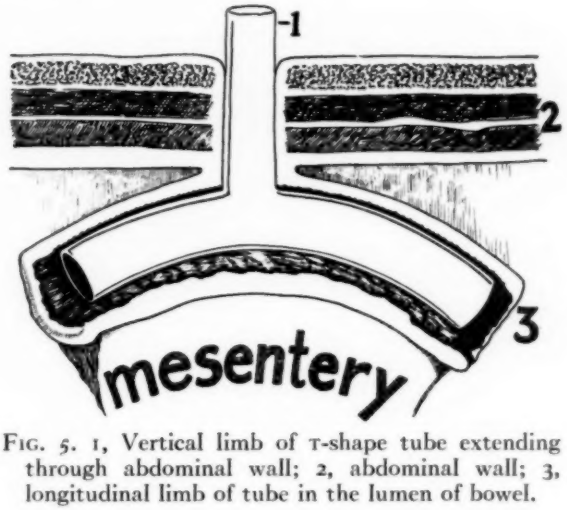

Fig. 5. 1, Vertical limb of T-shape tube extending through abdominal wall; 2, abdominal wall; 3, longitudinal limb of tube in the lumen of bowel.

Certain problems were expected to arise in connecting the two barrels, in making a patulous and well functioning large bowel. The accident had disarranged the anatomy as follows: (1) approximately 60 per cent of the mucous barrel of the colon, from the midtransverse to the sigmoid portion was sacrificed; (2) in the reconstruction of the colon the transverse end was anastomosed to the sigmoid, traversing the abdomen in a straight line from the upper portion of the cavity to the lower pelvis. The newly formed colon was suspended over many coils of the small bowel, resulting in the formation of adhesions and retraction of the cuff of serous and muscular coats of the two opposing loops.

Normally only one coil of small bowel is traversed by the colon- "duodenojejunal junction" and this is protected from colon pressure by the ligament of Treitz. It will be shown in the construction of the colon that the small bowel did interfere with the application of the clamp by the Mikulicz technique.

On January 31, 1935, under ether anesthesia, through a combined linear and elliptical incision the blind pouch of distal loop including the colostomy limb was freed of the adhesions down to the peritoneum which was entered along the left mesial surface and the two colon barrels approximated with interrupted black silk and catgut sutures, retracting all the visible coils of the small bowel. The blind

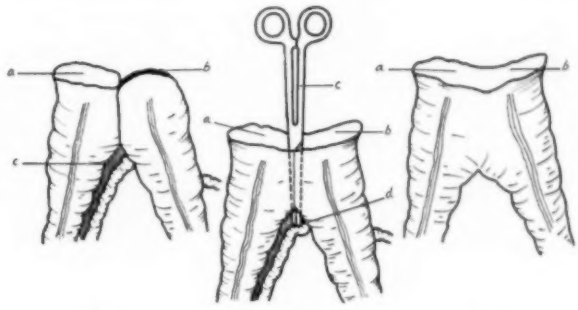

Fig. 6A. Second operation Jan. 31, 1935, the colostomy and blind pouch barrel of sigmoid were freed of adhesions down to peritoneum; blind pouch incised; both colon limbs further approximated with catgut and black silk and constricting septum of the two colon loops incised transversely and closed longitudinally; *a*, the colostomy barrel; *b*, closed sigmoid barrel; *c*, adhesions of small bowel to the two colon barrels.

Fig. 6B. Third operation Feb. 28, 1935; application of clamp. *a*, colostomy opening; *b*, sigmoid opening; *c*, clamp applied to septum of the two colon loops; *d*, clamp catching coil of small bowel when applied to septum producing fistula of small bowel at base of the stoma.

Fig. 6C. Fourth operation March 19, 1935; closure of colostomy; *a*, and *b*, represent the colostomy opening.

pouch was incised and the septum between the loops was excised transversely and closed longitudinally, attempting to enlarge the lumen to a size which was sufficient to take care of its need. But inflammatory lesions of colon behave as any other mucous lined viscus in that the chances for reclosure of the lumen will often interfere with its function. Thus additional excision by surgery or clamp is required.

Approximately one month later, a digital examination was made which revealed a firm spur with its greatest density along the distal barrel on the mesenteric border. The mucous barrel was pulled externally and under guidance of the finger the clamp was applied, crushing the spur 3 to 4 inches, and each day tightening it an additional notch. On the fifth day the clamp cut through and within a short time the same day there appeared a small bowel drainage at the base of the newly formed stoma (Fig. 6B). In applying the clamp to the spur the clamp extended beyond the spur and caught a portion of the small bowel, producing the fistula, additional to the colostomy. We soon

saw that the drainage of the small bowel fistula produced less skin irritation than the previous jejunal fistula and the amount of

FIG. 7. *X*-ray picture of the colon as of May 1, 1936.

drainage was not as great. In this fistula there was not the body wasting and toxemia that was found in the jejunal fistula. The conclusions were that we were dealing with a fistula lower down in the small bowel, presumably the ileum. No special treatment was given to correct this accidental injury except for occasional tamponading of the opening in the small bowel with gauze. At this time the patient returned home and was kept under observation until July.

On July 10, 1935, under ether anesthesia, through an upper right rectus incision, extending from ensiform to below the umbilicus, the abdomen was explored. Several coils of the small bowel adherent to the two colon barrels were freed, and the loop of the small bowel (ileum) that furnished the fistula was detached from the colon spur. The rent in the bowel was closed in a transverse direction. The colon barrels were further approximated with black silk and catgut to a point close to the retroperitoneal wall, thus permitting only one coil of the small bowel (jejunum) to escape. The abdomen was closed without drainage.

In October, 1935, the lumen of both barrels of the colon were reexamined digitally. We found that the colostomy barrel was narrowed

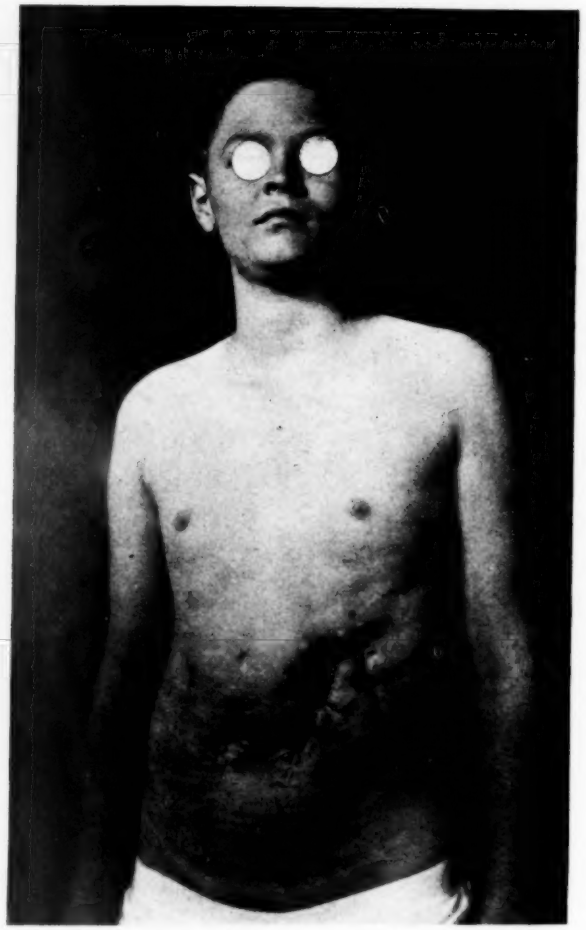

FIG. 8. Patient, as of August 8, 1936, a normal boy.

by a constricting spur which was sufficient to interfere with the closure of the colostomy. The mucous barrel was now brought forward toward the colostomy opening and the clamp was applied to the spur for 4 inches. On the following fourth day the clamp cut through, thus giving the lumen of the colon sufficient space to take care of its need (Fig. 6c).

In March, 1936, the colon was rechecked for additional spurs and it was found free. Then under ether anesthesia the colostomy was freed from the skin down to the peritoneum and closed in a transverse direction. The abdominal wall was closed with interrupted catgut and silk sutures with a wick drain. The wound was reinforced with adhesive strips which were placed in a criss-cross manner. After four to six weeks the patient was permitted to take supervised exercise. At the present time he is

having one or more normal bowel movements each day (Figs. 7 and 8).

CONCLUSIONS

1. The mortality from penetrating wounds of the abdomen with visceral injury is in proportion to the time that elapses after an accident and the time that surgery is instituted. The mortality is 40 to 50 per cent in cases where the injured person is given immediate surgical treatment, whereas the cases which are permitted to reach the peritonitis stage before any attempt is made for surgical repair are all fatal.

2. Permanent colostomy at the transverse colon and the closure of the sigmoid loop would have reduced the time of the operative procedure, and very likely this treatment would have had the sanction of many experienced surgeons in treatment of similar colon injuries.

3. If the sigmoid had been permitted to remain loose in the pelvis and an attempt had been made later to connect it with the colon when the patient's condition permitted, the results for obtaining a patulous colon would have been problematical due to the pathological changes, such as lack of development of sigmoid with the growth of the child and the subsequent adhesions which follow injury.

4. Although after our operation the sigmoid loop developed into a blind pouch and remained so for approximately two years, the anastomosis kept the two colon barrels in apposition and made it accessible for some form of reconstruction operation.

5. The value of continuous intravenous drip cannot be over estimated in a case of acute toxemia which is associated with infection, whether the infection originates in the peritoneal tissue or elsewhere. The daily average of intravenous glucose and saline in the present case for the first five days ranged from four to eight liters per day.

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STAB WOUND OF HEART, RIGHT VENTRICLE*

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NEW YORK CITY

CARDIORRHAPHY is no longer an interesting curiosity but a formidable challenge to the surgeon's ability to save lives. Statistical study of cardiac wounds shows a definite decrease in mortality with wider interest in surgical intervention. Peck in 1910, reported 160 cases with a mortality of 63 per cent. In 1912, Pool added 77 more cases to the literature, the mortality this time having been reduced to 45 per cent. Smith and Schoenfeld reported 74 cases, the mortality of which was 31 per cent. In these statistics inaccuracies are inevitable because many cases of attempted suture doubtless terminated fatally and were not reported.

The great French surgeon, Ambroise Paré, (1510–1590) was among the first to remark on the possibility of survival in a patient with a wounded heart. Early in the seventeenth century, Weber had dissected an elk and found a healed scar at the apex of the left ventricle. But a strong prejudice persisted that all heart wounds were fatal. As late as the close of the nineteenth century, so eminent a surgeon as Billroth remarked, "Let no man who hopes to retain the respect of his medical brethren dare to operate on the human heart." In the history of heart wounds, we find the name of Morgagni (1776) preeminent because it was he who first described heart tamponade as one of the causes of death in heart wounds. In 1793, Maron Larrey with a needle removed fluid from the pericardium. Fisher, in 1868, collected 452 cases of heart wounds of which approximately 10 per cent survived without operative interference. In 1882, Block sutured the heart of a rabbit. In 1894, Del Vecchio demonstrated healed cardiac wounds of a dog that had been treated surgically. The first case of suturing of a human heart was reported by Cappelen of Christiana in 1895. His patient died five days later but the wound was in good shape. Rehn was the first surgeon to suture the heart of a man who completely recovered.

Stab wounds of the heart which reach operation are still sufficiently rare to merit report of an additional case. Our survey of the literature until 1932 revealed 365 operated cases. The location of the heart wound was distributed as follows: left ventricle 167; right ventricle 125; left auricle 19; right auricle 21; miscellaneous 33. This does not include the 58 wartime cases reported by Sir Charles Ballance in his Bradshaw lecture, which makes our grand total 423 cases. Dshnelidze in a Russian article reported 535 operated cases but unfortunately his sources are inaccessible.

Although haste is imperative once the diagnosis of heart wound has been made, certain important elements in the preparation should not be omitted. In cases which appear to have had a successful suture, the most common cause of death is infection. According to Peck, infection is present in over 5 per cent of recoveries and in 50 per cent of fatal cases. Consequently, a careful scrubbing and iodinization of the skin and the use of instruments that have been properly sterilized, are necessary. Anesthesia apparatus providing differential pressure is a valuable adjunct in case pneumothorax develops. Preoperative treatment is ordinarily minimal on account of the urgency of operation. It appears, however, that cardiac embarrassment is lessened in many cases by placing the patient in a sitting rather than recumbent position. Blood typing with facilities for transfusion and infusion may prove life-saving precautions.

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Many cases are comatose and no anesthesia is required until cardiac embarrassment is relieved. Then light, open cone ether will carry the patient safely. The rib-flap operation has been the operation of choice. An over and over suture or a mattress suture of the heart may tear through, particularly in the thin right ventricle or in the auricles, whereas purse string suture may succeed, or suturing the pericardium to the heart wall may close the defect. Minimal handling of the heart may make the difference between successful and fatal outcome. Handling about the base of the auricles is particularly dangerous on account of the presence of vital nerve centers. Drainage at the lower end of the sutured pericardial wound is desirable but no drains should enter the pericardial sac.

CASE REPORT

History. J. S., a white man, age about forty years, was picked up from the street by the ambulance. He was unconscious, his breathing labored, his face cyanotic with its veins and the veins of the neck and arms dilated. The pupils were dilated, pulse was imperceptible but the extremities were warm. A 5/8 inch almost horizontal stab wound was found in the left anterior chest, in the fifth interspace just to the left of the sternum. There was moderate oozing from this wound. A second wound about one inch long with omentum protruding from it was located in the left upper quadrant of the abdomen. The heart margins were not readily defined. The heart sounds were inaudible, as there were numerous rales throughout the chest. The blood pressure was zero.

A diagnosis was made of stab wound of the heart with heart tamponade, complicated by stab wound of the abdomen. Immediate operation was decided and infusion was started preoperatively.

Findings. On reflecting the skin and pectoral muscles, a 1/4 inch triangular metallic fragment, like a metallic scale was found in the depths of the wound. The stab wound had penetrated at the angle between the costal cartilages and the sternum in the fifth interspace. On entering the thorax, a left pneumothorax developed, and the lung overlying the heart retracted. The tense pericardium with blood clot shining through it was incised and the clot evacuated. The left auricle and ventricle were intact. Rotation of the heart revealed oozing from the right heart. The heart was beating weakly and irregularly. A clot adherent to the right ventricle was removed. Blood spurted through a half inch wound which, at the time, was believed to be leading into the right auricle.

Operative Procedure. Without any anesthesia, a semicircular incision with concavity upward and to the left, was made. The incision was placed to the left of the sternum and overlying the third to the seventh costal cartilages. The skin and pectoralis muscles were quickly elevated and the third to the seventh costal cartilages severed near the sternum. The fourth, fifth and sixth ribs were fractured at the nipple line and the osteomuscular flap hinged laterally. The pleural cavity was inadvertently entered. The left lung immediately retracted. The pericardium was slit longitudinally and the clot evacuated. The heart was elevated with the left hand, the adjacent left side of sternum was resected and the remaining right side retracted. The heart was rotated and the clot removed from over the right ventricle. The half inch wound of the right ventricle was sutured with continuous suture of No. 1 plain catgut. When the last suture had been inserted the heart ceased beating. The patient had been getting saline intravenously. Adrenalin had been administered three times, the last time into the heart itself. Artificial respiration and cardiac massage were all without avail.

Auotpsy Report. There is a sutured stab wound on the anterior wall of the right ventricle below the conus, 1 1/2 inches below the right auricular appendage, and 2 inches to the left of the interventricular sulcus. This wound is held together by a continuous suture which when removed, exposed a cut wound of the heart, measuring 1/2 inch in length; the edges are approximated. Three-quarters of an inch beneath this wound, there is a smaller wound, also a penetrating stab wound of the heart, 3/8 inch in length, the edges of which are cut clean. This wound also leads into the cavity of the right ventricle. It is possible to pass a probe through the superior wound in the ventricle and out to the inferior wound which may represent the continuation of the tract.

COMMENT

This case of stab wound of the heart is rather exceptional, in that it was complicated by two right ventricle wounds, only one of which spurted blood at operation. It was further complicated by a stab wound of the abdomen with protrusion of the omentum.

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Care of Rubber Gloves:

1. All gloves should be washed in cold water before being removed. (This should be insisted upon in every operating room.)

2. After removal all gloves are again washed inside and out with cold water and soap by the nurse.

3. All gloves are wrapped in a piece of muslin and boiled for five minutes. (Muslin is used to keep the glove from sticking to the sides of the sterilizer.)

4. After boiling, the gloves are lifted out of the sterilizer and the water drained off. They are removed from the muslin package and hung on a glove tree to dry, placing a prong of the tree into one finger of each glove. If there is no tree, the gloves may be hung over cloth covered rods stretched across a drying closet (small steam heated room).

5. When gloves are dry on the outside, they are turned and allowed to dry on the inside.

6. When dry, they are sent to the work room to be repaired, powdered and put up in labeled packages.

Operating Room Procedure by Henry C. Falk, M.D.

MUCOCELE OF APPENDIX WITH PSEUDOMUCINOUS DEGENERATION*

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MUCOCELE of the appendix was first recognized as a pathological entity of Rokitansky in 1842.[1] It was again mentioned by Virchow in 1863,[1] and Werth is credited with giving the term "Pseudomyxoma peritonaei" in 1884, because of the gelatinous masses which he found throughout the peritoneal cavity, and which was proved to be pseudomucin instead of mucin. Fraenkel in 1901 reported a mucocele of the appendix in the male, which ruptured and he retained the term "pseudomyxoma peritonaei" because of the gross similarity of the gelatinous exudate to that found in cases previously reported under the same name in women. A little later Olshausen wrote that he believed the epithelial cells from the lining of the ruptured cyst were transplanted to the peritoneum, and that there they took root and continued to secrete the gelatinous material. As to frequency, Castle[2] reported a 0.2 per cent of mucocele of the appendix in 13,158 necropsies. Dodge, in 1916, reviewed the literature and found only 142 cases reported. Norment[3] studied 45,000 appendices removed surgically at the Mayo Clinic and found 36 mucocele cysts. Weaver,[4] in 1928, was able to find 168 reported cases of mucocele of the appendix. In April, 1932, Mayo and Fauster[5] studied 31,200 appendectomies performed in the Mayo Clinic from 1917 to 1930, with a total of 76 pathologically proved cases of appendiceal mucocele. This last series did not include 6 cases of pseudomyxoma peritonaei originating from mucocele of the appendix reported by Masson and Hamrick,[6] of the Mayo Clinic, in 1929. I am now able to report on 6225 appendectomies studied pathologically at the Hollywood Hospital in the ten years from 1925 to 1934, inclusive. In this series of appendectomies 7 mucoceles of the appendix were found, one of which, the case reported, had gone on to pseudomyxoma peritonaei. The percentage of this series is 0.11. Totalling the available reported cases there were 256 instances of mucocele of the appendix, either with, or without the existence of pseudomucinous peritonaei.

Two aspects of the disease present themselves in the clinical picture; the first is circumscribed and is caused by the fact that the mucinous fluid remains confined within the walls of the appendix, thereby forming a cyst; the second step, or stage, of this disease is a diffuse myxomatous invasion throughout the whole peritoneal cavity, producing myxomatous degeneration. If spontaneous perforation of the appendiceal mucocele occurs the gelatinous fluid will seep through the small opening, and, by means of peristalsis of the intestine, be deposited in any part of the abdomen.[7]

There are many explanations quoted concerning the continuation of mucinous, or pseudomucinous fluid found outside of the original cyst, or cysts. It seems most probable that the appendiceal mucus cells are carried away into the peritoneal cavity, attaching themselves to the peritoneum, thus continuing to function and produce the mucinous fluid. This explanation seems very probable with the pathological report in mind of the case to be reported.

Pertaining to the percentage of occurrence of mucocele of the appendix it seems probable that 0.2 per cent of all cases of

* Read before the Los Angeles Surgical Society, October 18, 1935.

appendiceal pathology is nearly correct. It happens occasionally that as a result of an attack of acute appendicitis, which has stopped short of perforation, or, has subsided spontaneously, that a stricture is formed in the proximal part of the appendix at, or near, its junction with the cecum.[8] If the original infection dies, or remains of so low an intensity as to stimulate the mucus secreting cells without leading to further attacks of acute appendicitis, the appendix may become distended with mucus, and, as the pressure within the now closed viscus rises, hernial protrusions of the mucous membrane projects through the muscular coat and form diverticula, which are recognizable as spherical swellings beneath the peritoneum. Such distention of the appendix may increase slowly until the organ becomes many times its normal size, or, at any point its progress may be cut short by a rupture of one of the diverticula. If this occurs the mucus is discharged into the peritoneal cavity, the appendix collapses, the rupture of the diverticulum heals, and the process commences again. This sequence may be repeated at periodic intervals for many years before it causes symptoms or physical signs sufficient to achieve clinical recognition. Exuded mucus is not absorbed by the peritoneum, but becomes encapsulated in the form of droplets or larger masses, either by the omentum or by the growth of filmy connective tissue produced by a local plastic peritonitis, as was found in the case to be reported. In the course of time the abdomen becomes distended by gelatinous masses (pseudomyxoma peritonaei) as in the more common, allied condition caused by rupture of a mucus secreting ovarian cyst.

Present day knowledge is not sufficient to answer the question as to whether the pseudomucinous fluid in the abdominal cavity is inflammatory or neoplastic. That it may be inflammatory is supported by the fact that a pseudomucinous condition has been reported in some cases to have spontaneously regressed, while in others it took a neoplastic course.

Therapy consists in removal of the diseased appendix and as much as possible of the mucinous material. Bearing in mind that a malignant degeneration[6] may take place, postoperative irradiation is justified. In reviewing the literature no definite *x*-radiation therapy is advised by the authors as to dosage, filtration, etc.

CASE REPORT

Mrs. A. H. S., aged seventy years, female, white, a motion picture actress, complained of enlargement of the abdomen, constipation and some loss of weight.

Family History. Father died, aged sixty-six years, of tuberculous peritonitis; her mother died, aged ninety-four years of senility. The remainder of the history was irrelevant.

Past History. Measles, mumps, pertussis as a child, pneumonia at the age of 12 years. In 1901, at the age of thirty-six years, she had an attack of appendicitis and was bedridden for three months but was not operated. In 1904, she had typhoid fever with uneventful convalescence. Patient was born in the South.

Menstrual History. Menses began at fourteen years, with uneventful menopause at the age of fifty years. She had never been pregnant.

Present History. About three years ago patient noticed a gradual enlargement of the abdomen, which caused her no distress; however, recently her chief complaints are slight loss of weight, enlarged abdomen, poor appetite, easily exhausted and obstinate constipation.

Physical Examination. Her temperature is 99.4°, pulse rate 96, and blood pressure 134/60; height 5′8″ and weight 143 pounds. The general appearance is that of a tall, angular type woman of apparent age of seventy years, in no pain and very talkative.

Head and neck, eye, ear, nose and throat, heart and lung examinations are essentially negative for her age. When standing, the abdomen protrudes very markedly. Measurements of abdomen at the level of the umbilicus is 44 inches. When lying flat there are no masses palpable within the abdomen, no tenderness and palpation note is flat throughout.

Vaginal Examination. Except for a urethral caruncle there is very little to be palpated. The uterus is small and has undergone senile

atrophy. One can palpate apparent fluid anterior to the uterus and in either adnexal region. Rectal examination confirms vaginal.

Extremities. Arms and legs are negative, and no edema is evident.

Essential Laboratory Findings. The urine is negative.

Blood. 3,910,000 erythrocytes, 60 per cent hemoglobin, 8050 leucocytes, 62 per cent polymorphonuclears, 5 per cent large monocytes, 28 per cent lymphocytes, 3 per cent eosinophiles and 2 per cent basophiles. The coagulation time is 6 minutes 15 seconds.

X-ray studies of gastrointestinal tract, November 5, 1934, are essentially negative; the appendix was not observed at any time during the series. Roentgenogram of the gall bladder reveals no dye showing at any time in the gall bladder and therefore diagnosed as a non-functioning gall bladder. A barium enema reveals a highly spastic descending colon, otherwise negative.

Operation, November 23, 1934, under spinal anesthesia, making a midline incision from the pubis to 3 inches above the umbilicus. On entering the peritoneal cavity it was found that a huge cyst was attached to the peritoneum of the anterior abdominal wall. This was easily separated and one could palpate a large cystic mass completely filling the abdomen, from the pelvis to the diaphragm. In attempting to free the cyst wall as it passed posterior to the greater omentum, the cyst ruptured and was evacuated of slightly over two gallons of gelatinous, colloid material. The cyst wall was attached to the pelvis, extending up both sides of the abdomen, attaching itself to the inner lateral aspect of the ascending and descending colon, going underneath the omentum and stomach and was attached to the posterior peritoneum above the left kidney, the root of the mesentery below the liver, and to the jejunum near the ligament of Treitz. In peeling off this cyst wall, which was very fragile, many small pieces of the wall were undoubtedly left within the abdominal cavity. There were also large groups of colloid material above the stomach, and between the liver and the chest wall. These were cleaned out as well as possible with the gloved hand. Where the cyst wall was attached to the inner lateral side of the cecum it was found that the appendix penetrated the cyst wall and extended downward, parallel to the right side of the rectum, a distance of 7 inches. The cyst wall was cut down to the root of the appendix and an appendectomy done. It was found that the appendix had undergone complete calcareous degeneration, with the end of the appendix lying open and containing a fecalith, the size and shape of an olive seed. Both ovaries had apparently undergone complete calcareous degeneration and were extremely hard to palpation. The left ovary was removed for diagnosis. The patient left the table in fair condition.

Pathological Report. The specimen consists of a fibrous wall showing quite a little colloid material on the surface. The wall itself is rather thick, presents many small cysts filled with colloid, giving the impression that it is a colloid carcinomatous condition. The ovary is irregular in outline, measuring 3.5 by 3 by 2.25 cm., calcified. What has been taken for the appendix is a tube measuring 5 cm. in length by 2.25 cm. diameter. Its outer surface is rough with many adhesions. Cutting through the wall it is calcified, giving the impression of arteriosclerosis. Its central part contains a partially organized clot. At the tip is a piece of tissue shaped like a date seed and measuring 2.25 by 1 by 0.7 cm. It is a little rough, translucent in appearance and fairly firm.

Cyst Wall. Portion of the cyst wall is fibrous and on either surface there are small colloid cysts, giving a definite impression of carcinoma. Specimen measures six quarts, weighs 13½ pounds.

Microscopic section from what was taken to be the appendix shows a typical appendiceal wall, fibromuscular structure with the lumen presenting very little round cell infiltration but hypertrophy and hyperplasia of the cylindric cells of the lining mucosa, which are actively secreting mucus. There is no invasion of the muscular structures. The calcified wall presents quite a typical bone formation with some calcified material.

Section from various parts of the cyst wall shows a fibrous structure with scattered pockets of mucoid material with quite a little round cell infiltration. Occasionally one sees cylindric cells on the surface of these cysts actively secreting mucus. At no point, however, do they invade the wall. No mitotic figures are recognized and the cells are quite normal as to size, shape and staining properties. At no point is there any evidence of a colloid carcinoma as

would be shown by the eccentric nuclei. I am inclined to view the condition as a mucocele of the appendix, especially the distal end which has ruptured and produced a pseudomyxomatous peritonei, which occurs sometimes in this condition. The condition is not malignant in the sense that a carcinoma has developed, but is malignant clinically in that the condition tends toward the death of the individual.

Microscopic section of the ovary shows quite typical bone formation throughout.

Mucocele of the appendix with pseudomyxomatous peritonei.

This patient went through an uneventful convalescence and on December 22, 1934, thirty days postoperatively, was started on *x*-ray therapy to January 11, 1935, a series of fourteen treatments, receiving 1386 *r* units over the abdomen and 1192 *r* units over the pelvis.

SUMMARY

A short history on mucocele of the appendix is presented, and a report is given of those found in a total of 6225 appendectomies studied pathologically at the Hollywood Hospital in the ten year period from 1925 to 1934, inclusive, with a percentage of 0.11. The total number of available reported cases in the literature is 256.

The interesting features of the case presented was that the first and only known attack thirty-four years previous to operation was treated conservatively; the patient was in bed for three months and was not operated. At the time of operation about nine quarts of mucinous material was removed. The postoperative treatment is discussed, in that this case was treated as a low grade malignancy and received deep *x*-ray therapy following operation. Two years postoperatively, the patient shows no evidence of recurrence of the disease.

Recent check-up of this patient in December, 1936 reveals her to be apparently in good physical condition. The abdomen now measures 33 inches in circumference at the umbilicus and there is no evidence of a return of the disease.

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GASTROJEJUNOCOLIC FISTULA*

A BRIEF REVIEW OF THE LITERATURE AND REPORT OF A CASE

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IN 1903 Czerny reported the first case of gastrocolic fistula following gastroenterostomy. The 70 previously reported originated from cancer of the stomach or colon. In 1912 Haudeck made the first roentgen ray diagnosis of gastrocolic fistula caused by carcinoma of the stomach. Burnham in 1917 reported the first carcinoma of the colon with fistula into the stomach, in which the diagnosis was made with roentgenograms. Verbrugge in 1924 studied all previously reported cases and wrote the most complete article on the subject. He collected 202 cases from the literature and added 14 more, making a total of 216 cases. Since then up to 1930, 13 more cases were added by various authors, making a total of 229 cases reported from 1903 to 1930.

ETIOLOGY

Verbrugge noted that fistulas due to carcinoma were decreasing and that those due to gastrojejunal ulcer were increasing with the growing popularity of gastroenterostomy for the treatment of gastric and duodenal ulcer. Trauma, abdominal tuberculosis and gastric ulcer are uncommon causes. Early diagnosis and intervention in cases of cancer of the digestive tract have lowered the number of these large tumors so that fistulas due to their extension have been reduced.

The incidence of fistulas following gastroenterostomy is variously stated. It is quite excepted that when it does occur it is usually in the period from a few weeks to nine and one-half years after operation. Its occurrence is dependable on the number of jejunal ulcers that appear postoperatively.

Most authors agree with Pratt that jejunal ulcers following gastroenterostomy practically always occur in the group of cases whose original trouble was a duodenal ulcer rather than gastric ulcer.

Lewishon, of Mt. Sinai, claims jejunal ulcer occurred in 35 per cent of the gastroenterostomy cases for duodenal ulcer done at Mt. Sinai between the years 1915 and 1920. Most all other authors consider these figures too high.

Balfour states that the occurrences of gastrojejunal ulcer in a series of 500 cases of gastroenterostomy for duodenal ulcer observed over a ten year period was 3.26 per cent; the British Medical Association survey of 744 cases observed over a period ranging from four to nine years was 2.8 per cent, and the Germans report 5 per cent. Mayo and Rankin estimate that gastrojejunal ulcer occurs in 1 to 3 per cent of patients following operation for gastric and duodenal ulcer. Lahey in 1935 wrote, "It is interesting to note that gastrojejunal ulcer is now considered a serious and not unlikely complication of any operative procedure for ulcer in which the stomach is anastomosed to the intestine and not a sequela peculiar only to gastroenterostomy."

The etiology of gastrojejunal ulcer is still in a state of hypothesis. Supposed causes are: (1) sudden exposure of the jejunum to hyperacid gastric contents; (2) the use of unabsorbable sutures and Murphy buttons; (3) operative trauma to the mucosa by use of heavy clamps, etc. and (4) focal infection. In addition, other factors that contribute to this sequela of gastroenterostomy, are: (1) carelessness in postoperative diet and medical supervision; (2) the same causes that produced

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the original ulcer; (3) type of operation, (particularly frequent after von Eiselberg pyloric exclusion operation); (4) breaking down of hematoma; (5) syphilis; (6) faulty operative technique, particularly placing the anastomosis too high (Woolsey); (7) excessive smoking, alcoholism and the use of condiments; (8) fatigue and exposure, and (9) arteriosclerosis. In other words, the cause of jejunal ulcer is really unknown. However, it is definitely known that primary ulcer of the jejunum is extremely rare.

AGE AND SEX

All patients at the Mayo clinic series were between twenty-seven and sixty-one years of age. In all the reported cases, all but one were males. Eusterman asserts that the proportion of males to females affected with gastric and duodenal ulcers is 3:1, and that with jejunal ulcers is 6:1.

PATHOLOGY

Fistulas in cases of carcinoma of the stomach or colon are part of the tumor itself. Fistulas due to perforation of a jejunal or gastrojejunal ulcer are essentially different. In brief, first a duodenal ulcer or other gastric pathology, then following a gastroenterostomy an ulcer develops at the stoma and spreads around the jejunum. The perforating ulcer, and all jejunal ulcers tend to perforate, becomes plastered to the colon and finally perforates it, forming the fistula. After perforation the ulcer, as a rule, heals and the mucosa appears normal. This process is accompanied with more or less adhesions depending on the amount of spreading local peritoneal inflammation. In many cases the efferent jejunum becomes swollen and thickened due to infection from the colon.

SYMPTOMS

The symptoms of gastrojejunocolic fistula are along the lines of evolution. There is first, the symptom syndrome of the associated lesion. In cancer of the stomach or colon, the usual findings of these diseases, then at some time or other perforation occurs, with more or less abdominal pain, to be followed by the symptoms of fistula.

In the jejunal ulcer cases, the patient has been operated upon for his primary gastric or duodenal ulcer with a definite improvement in his health over a period of six months to nine and one-half years. Then he may, or may not, have the symptom complex of jejunal ulcer to be followed by the findings of fistula which are:

1. *Diarrhea.* This is the most constant of all symptoms and results in the patient's loss of general good health. Stools average six to ten a day; are usually yellow, soft, with strong foul odor, acid in reaction (due to gastric secretions or fatty acid) and contain neutral fats. Lienteric stools may occur. It does not yield to medication as a rule.

2. *Eructation* of foul gas is often present. Often medication given in an enema may be tasted.

3. *Vomiting* of fecal material is not a common occurrence, but when it occurs in the absence of intestinal obstruction, it is pathognomonic of the disease.

4. *Pain* is rare and not dependable. It may be localized above the umbilicus from the perforating ulcer, or cramps that are generalized, due to partial intestinal obstruction.

5. *Loss of weight* occurs although the patient has a normal appetite. The loss is sometimes considerable, accompanied by marked dehydration and general weakness.

PHYSICAL SIGNS

These vary considerably and are of little value. Abdominal palpation is usually negative. Peristalsis is active and perhaps high pitched sounds may be heard over the fistula. Occasionally in the emaciated patient, peristalsis may be seen.

DIAGNOSIS

Wasting without apparent cause, abdominal discomfort or pain (usually with a previous history of jejunal ulcer), fecal

smelling eructations, fecal vomiting without evidence of obstruction, or alimentary vomiting in which the presence of stercobilin and indole can be demonstrated, diarrhea, the stools containing undigested food, fats and hydrochloric acid. Colored meals rapidly appear in the stools. Colored enema solutions are quickly recovered by gastric lavage. Roentgenographic study is most important in establishing the diagnosis, which must be differentiated from incomplete intestinal obstruction or an acute peritonitis.

PROGNOSIS

It is usually fatal unless there is surgical intervention. In Loewy's series of 26 cases, 11 patients who were not operated upon died.

TREATMENT

Since jejunal ulcers are the most important single entity as the cause of gastrojejunocolic fistula, prophylactic measures are paramount. They may be outlined briefly as follows: (1) strict diet following gastroenterostomy, no smoking, alcohol or condiments; (2) proper administration of alkalies; (3) moderation in habits and living. When the diagnosis of fistula is established, operation is indicated, losing little or no time in preoperative treatment. The water balance should be established and acidosis, if present should be combated. The operative procedure should be as simple as possible, each case making its own demand on the judgment of the surgeon. Operation may be a simple closing of the fistula and the undoing of the gastroenterostomy, or extremely radical with "bloc" resection of the part of the involved colon, jejunum and stomach.

It must be remembered, as Lahey points out, that the undoing of the gastroenterostomy leads to recurrence of the duodenal ulcer.

According to Loewy's statistics in 63 operations of all kinds, there were 61.9 per cent cures, 11.1 per cent definite recurrences, and 27 per cent deaths. Lahey's mortality is given as 15 per cent. Of the 20 cases operated upon at the Mayo clinic, 4 partial resections of transverse colon were made; in 15, the fistula was closed; in 11, the old gastroenterostomy was cut off; in 4, a new one was made; in 2, the old gastroenterostomy was reestablished; in 3, partial resection of the jejunum was performed; in 2, pyloroplasty; in 1, jejunostomy and cecostomy. Five patients died; 2 following the resection of the colon for carcinoma, 1 from acute nephritis two years after operation, 1 from general peritonitis and bronchopneumonia, and 1 from indefinite cause.

CASE REPORT

A white male, aged thirty-six years, entered the Lutheran Hospital, Brooklyn, N. Y., on March 3, 1926, and was discharged March 25, 1936, three weeks after admission. His chief complaints were diarrhea with six to seven bowel movements every twenty-four hours; lost sixty-one pounds in weight during the last two years; extreme weakness; normal appetite.

Laboratory Data. Red blood cells 4,410,000; hemoglobin 80 per cent; white blood cells 9400; polymorphonuclears 68; lymphocytes 26; eosinophils 1; basophils 1 and monocytes 4 per cent. The urine was negative. The blood Wassermann and Kahn tests were negative; blood sugar 72.2; non-protein nitrogen 33.8; creatinin 1.46 mgs. per 100 c.c. Gastric analysis reported from Queens General Hospital showed a normal curve. His stools were negative for ameba. His blood pressure was 92/66. Patient now weighs 114 pounds, is emaciated and dehydrated.

Physical findings are negative, except for an old upper right rectus incisional scar, three inches long.

Past History. In April, 1922, he had a duodenal ulcer, for which a posterior gastroenterostomy and appendectomy were performed at the Mare Island Hospital, California, May 2, 1922. After three months he was discharged having made an uneventful recovery. He enjoyed good health up to two years ago when he suddenly began to have diarrhea, six to seven stools a day, not accompanied by any pain, tenesmus, blood, or mucus in the stools. There was no nausea or vomiting. The stools were liquid mostly. He was seen in May, 1935, and while under treatment, was free from

diarrhea for three months, having only two formed stools daily and gained thirty pounds in weight. In August, 1935, his diarrhea reappeared and he entered the Lutheran Hospital, August 5, 1935, stayed one day and left, no work-up being done. In February, 1936 he entered the Queens General Hospital where a work-up was done and an *x*-ray diagnosis of "fistula connection between splenic flexure of the colon and greater curvature of the stomach" was established by Dr. Startz.

The patient returned to Dr. Morsch, to whom we are indebted for this interesting case. He was admitted to the Lutheran Hospital on March 3, 1936, with the mentioned history, Dr. A. L. Voltz confirming the previous *x*-ray diagnosis. On March 13, 1936, the operative findings showed a normal gall bladder, apparently normal stomach and duodenum with no evidence of the old duodenal ulcer but there was a posterior gastroenterostomy, at the anastomotic line of which, close to the greater curvature of the stomach, a fistula into the transverse colon three-fourths inches in diameter was found. The stoma at the enterostomy easily admitted two fingers. There were a moderate amount of adhesions. Sharp knife dissection of fistulous tract was performed with closure of the colon and reestablishment of the gastroenterostomy. Section of the fistula taken for biopsy was reported as "normal gastric mucosa."

His convalescence was uneventful, except that on the fourth postoperative day, he developed an acute catarrhal otitis media in the right ear. This had subsided before his discharge, twelve days postoperative. He had gained six pounds and his bowels were moving once a day.

In a follow-up three months later, the patient gained forty-six pounds; he has no complaints; his bowels are normal and he has resumed his usual duties.

SUMMARY

1. One should suspect a fistula in the presence of a persistent diarrhea following an operation for gastric or duodenal ulcer, associated with loss of weight, fecal vomiting and eructation of foul smelling gas, intestinal obstruction being ruled out.

2. Jejunal ulcer occurred in 1 to 3 per cent of all ulcer cases for which a gastroenterostomy had been performed. Of these, 10 per cent ultimately developed gastrocolic fistulas.

3. Once an ulcer patient, always an ulcer patient, regardless of the type of surgical treatment.

4. Postoperative gastric cases should be impressed that they must continue under strict medical supervision the rest of their lives. Habits are restricted, particularly the use of tobacco, and perhaps, alcohol.

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SYMPATHECTOMY FOR HIRSCHSPRUNG'S DISEASE AND POLYPOSSIS

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THE gratifying results of sympathectomy in the relief of Hirschsprung's disease recommend this surgical procedure in many cases and suggest its further efficacy in the treatment of conditions arising from obstipation.

CASE I. W. A. a girl, nine years of age, was admitted to the hospital April 23, 1935. Her maternal grandparents were tuberculous. This child was four days old before a movement of the bowels could be produced by glycerine suppositories and Epsom salts. She had never had a natural evacuation and suffered frequent periods of complete obstipation. Diet had failed to affect this condition in any way. Salts and glycerine enemas produced only weekly or biweekly bowel movements.

Her abdomen was pendulous and greatly distended; the colon could be easily outlined. The urinalysis was entirely negative.

Operation. April 24, 1935. A midline incision was made below the umbilicus. The colon was found to be 3 inches in diameter with overdeveloped muscular coats. The length was increased and the colon felt thick and heavy throughout. The appendix was removed. The posterior peritoneum was incised vertically to the origin of the inferior mesenteric artery. Sympathectomy according to Rankin,[1] "The presacral nerve is divided at the right border of the left common iliac vein. . . . It is then raised upward by gentle dissection and the branches which reach it from the fourth lumbar ganglia are divided on each side . . . The connecting branches from the third lumbar ganglia are divided as they pass to join the nerve from beneath the common iliac arteries. When the nerve has been raised a little higher its lateral roots may be severed . . . " The two principal roots of the inferior mesenteric plexus were resected and the peritoneum closed. The abdominal incision was closed layer by layer, leaving 1000 c.c. normal saline solution in the peritoneal cavity.

[1] RANKIN, BERGEN and BUIE. Diseases of Colon, Rectum and Anus. Phila., W. B. Saunders & Co.

The patient's bowels moved satisfactorily without enema the second day after operation. Convalescence was uneventful and she was discharged May 4, 1935.

Four weeks later the patient reported three bowel movements daily without medicine of any kind and June 6, 1935 she reported two natural bowel movements daily. A year later the patient was in excellent health and had been attending school regularly. She was having two daily natural bowel movements.

CASE II. D. S. A young single woman, twenty-two years of age, was admitted December 5, 1935 with complete intestinal obstruction. Family history negative. This girl had menstruated once at twelve years and not again until fourteen; since then the interval is four weeks, duration seven days, amount excessive. She complained of severe pain that necessitated remaining in bed for seven days preceding the period and for two days after onset.

She gave a history of constipation of a year's duration, relieved only by enemas which, during the last month, had caused severe cramping. *X*-ray findings revealed an obstruction in the sigmoid flexure, filling defect of 2½ inches and gross polypoid involvement of the entire colon, sigmoid and rectum.

Because of the youth of this patient it was hoped that the semi-invalidism subsequent to extensive colon resection might be avoided. As an effort in this direction it was decided to attempt to relieve her condition by means of sympathectomy and *x*-ray therapy, leaving future colon resection contingent upon the results.

Operation. December 10, 1935. A left rectus incision was made from the level of the umbilicus to the pubis. The peritoneal fold across the sigmoid holding the sigmoid to lateral abdominal wall produced a kink causing partial obstruction. There was a small adhesion between the ileum and the uterus. The fold in the side peritoneum was lengthened about 1½ inches by cutting across and suturing

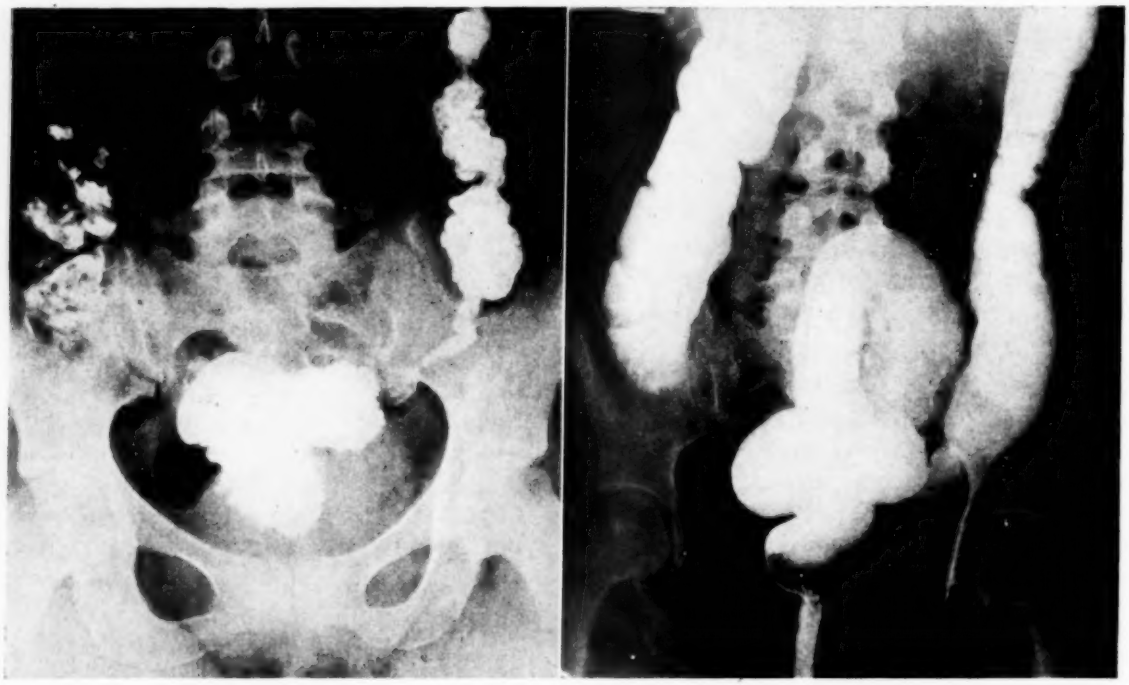
transversely. The adhesion between the ileum and the uterus was removed. The posterior peritoneum over the sacral prominence was incised and the presacral nerve with the connecting branches resected.

The patient's convalescence was uneventful. On January 3, 1936, she was given *x*-ray therapy and discharged.

Her next menstrual period was normal as to flow and painless.

On February 16, 1936 she was readmitted with complete obstruction caused by released polypoids temporarily lodged in the sigmoid colon. The intestinal tract was emptied with Levin's duodenal tube. On February 20 the patient passed large polypoid masses from the bowel. Bowels moved normally without medicine or enema. The patient was discharged.

X-ray examination on March 12, 1936 revealed a normal colon. June 1, 1936 the *x*-ray studies showed a normal colon. The patient reported one or two bowel movements daily without laxatives. Her menstruation is normal and painless.



A B

FIG. 1. Case of polypossis; A, before treatment; B, after treatment.

These reports are submitted as suggestions for the possible relief of these conditions without radical surgery.

SUMMARY

1. Hirschsprung's disease can be cured by sympathectomy. Aggravated cases of long duration often yield rapidly and satisfactorily to this treatment, presenting strong evidence in its favor.

2. Sympathectomy plus irradiation is a safe and rational procedure in the attempted relief of polypossis.

3. Sympathectomy does cure certain types of dysmenorrhea.

COMBINED ROENTGENOTHERAPY AND ULTRA-SHORT WAVE

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THE problem of increasing the radiosensitivity of malignant tumors has long been recognized as of primary importance in the treatment of cancer and has been approached from various aspects and angles. Gottwald and Schwarz[1] had shown that radiosensitivity depends in a large degree on the blood supply of the tissue, active arterial hyperemia effecting an increase of the radiosensitivity. Studying heating effects resulting in a local hyperemia, Rohdenburg and Prime[2] employed diathermy to heat in vitro the tumor cells and followed this with roentgen ray irradiation. They succeeded in obtaining more positive results by combined technique. Liebesny[3] was also able to produce a similar destruction of mouse carcinoma by means of diathermy alone, with only a partial and temporary destruction. Teilhaber,[4] Schwarz and Berndt, and Mueller,[5] using diathermy combined with roentgenotherapy in treating malignant tumors, reported favorable results. Nevertheless the combined technique has not found adaptation in general practice.

Since the introduction of short wave and ultra-short wave apparatus, numerous attempts have been made to utilize this agency for treatment of neoplasms. Schereschewsky[6] was the first to report the results of experiments on transplanted mouse sarcoma. In using ultra-short waves of 3 meter length the growth of the tumor was inhibited, and complete disappearance of the growth resulted in a few cases. Pflomm,[7] conducting a series of very precise experiments on Jensen rat sarcoma, found that under the short wave treatment of 4.5 meter length the tumor ceased to grow almost at once and later became reduced in size and necrobiosed. Histologic examination showed marked capillary hyperemia with a free transudation of blood at the periphery of the tumors, and a migration of parietal leucocytes through the vessel wall. Some thrombosis had occurred in the tumor vessels and finally focal necrosis was also observed over the entire area.

Reiter,[8] experimenting on Jensen sarcoma and Flexner carcinoma with short waves ranging from 3 to 15 meter length, stated that this irradiation has a specific biologic effect conditioned by the wave length, and is most apparent with waves under 4 meter length. A heavy dose produces a dilatation of the blood vessels. Histologic study of the treated tumors showed that wave length of 3.5 meters proved to be the most destructive.

Reiter[9] later investigated the effect of short waves on cell metabolism, and found that with a wave length of 3.4 meters there was a marked suppression of anaerobic fermentation of sugar, of as much as 80 or 90 per cent. In this particular, short wave irradiation differs from *x*-rays in that the action of the latter shows no effect on anaerobic metabolism. He excludes the effect of raised temperature as the possible factor responsible for this specific biologic action. His general conclusion is that the primary action of the short waves is on the metabolism of the cell directly, while *x*-rays interfere with the metabolism only through the direct damage to the cell itself.

Roffo[10] demonstrated that waves ranging from 0.58 to 6.75 meter length inhibit the growth of rat sarcoma in vitro, but not that of the embryo chicken heart. The irradiated rat sarcoma failed to take in an average of 40 per cent of the animals, as compared with the 100 per cent take in the non-irradiated grafts.[11] The irradiated grafts which did survive grew much more slowly than the controls.

Hill[12] investigated the growth of Jensen rat sarcoma with a weak dose of ultra-short waves alone, and also in combination with radium treatments. Evidence was obtained that ultra-short wave irradiation made the tumor more sensitive to radium, although either agent was ineffective when used alone, and the weak dose of ultra-short waves was too small to cause any serious injury to normal cells. There was also no rise in temperature to a degree which in itself might be lethal.

Mortimer and Osborne,[13] however, stated their belief that "heat alone was responsible for the therapeutic effect which the short wave generators produce." Hasche and Collier[14] found no evidence of a retarding effect on the growth of the tumor when Ehrlich mouse sarcoma in vitro was exposed to 3.5 meter waves. Eidinow[15] is also of the opinion that there is no specific action of the ultra-short waves of 3 and 4 meters. He believes that all ultra-short waves appear to act in the same way as the diathermy currents of longer wave lengths, which is by heating the tissues. Haas and Lob,[16] and in a later paper, Lob,[17] disclaim any specific action on the tumor by the short waves. Experimenting with the Jensen mouse sarcoma and carcinoma, they have observed no other action except a heating effect on the tumor. All their attempts to treat malignant tumors with short wave irradiation have given negative results. More recently, Dickens, Evans and Weil-Malherbe,[18] studying the effect of ultra-short waves on cancer tissue in vitro, concluded that only heat is responsible for the destructive effect of this irradiation.

The results obtained by Schliephake,[19] who used short wave treatments combined with *x*-rays in carcinoma of the uterus, seemed to be uncertain. He used two electrodes opposite each other, one plate over the uterus and another over the sacrum. Later he modified this technique using an internal vaginal electrode because of the pains produced in the sacrum. Wave lengths of 6 and 15 meters for forty minutes were employed. After several treatments a marked disintegration of the carcinomatous tissue was observed, but on stopping the treatments for a period of several weeks, the growth recurred.

The first detailed and thorough report on the combined short wave and *x*-ray therapy came recently from Fuchs,[20] who reported the work done at the City Hospital in Vienna. Liebesny's technique for application of short waves was followed, in which the heating factor is eliminated, the treatment being based on the specific electrical reaction only. The electrode-skin distance was at least 10 cm. in order to produce the desired depth effect; 15 meter wave length was used and the treatment lasted twenty minutes. *X*-ray therapy was applied a few hours after the short wave irradiation. Fuchs states that the combined technique produced no increase in the tumor growth and had no effect on the skin reaction with the Coutard technique. He believes that the combined technique is of eminent value in the treatment of neoplasms and urges its application in *x*-ray clinics.

TECHNIQUE

The biologic premises for this work are based on the non-thermal properties of short wave therapy.

According to investigation by Pflomm[21] and confirmed by Liebesny and others, the ultra-short waves possess a strong vasodilatory action. In Pflomm's experiments on frogs, after an application of U.S.W. there exists a marked vascular dilatation, especially of the capillaries, which remains for a few hours.

Pflomm pointed out that the temperature in the region treated did not rise above 26 or 27 degrees C. and that by simple heating none of these effects could be produced, except a very insignificant one of short duration. This specific athermic action was demonstrated by a series of experiments with adrenalin. The thermal stimulation was more or less completely

annihilated by adrenalin, but athermal dilatation remained unchanged.

Liebesny in his recent monograph[22] concluded that heat is not only useless but might be harmful. He avoids heating of the skin by increasing the air space between the skin and the electrode. Heating of the deep-lying tissues should be reduced by using a very weak intensity of current.

In applying short waves, their bacteriocidal action and analgesic effect should also be taken into consideration. Short wave treatments were found to be useful in relieving pain, the effect being quite lasting. As a rule, in cancer patients with infection, five daily short wave treatments preceded the combined course of treatments. Also in a series of postoperative cases with persistent suppuration, and in the erythemas of roentgenotherapy, short waves were found helpful.

For our work a short wave apparatus of 6 meter wave length and approximately 250 watt capacity was used, with circular rubber-protected condensor electrodes, 10 cm. in diameter and a skin-electrode distance of 7 to 12 cm., the "active" electrode having the shorter air space. In order to duplicate approximately the same dosage in each treatment: (1) the electrodes were adjusted to the same position at the same distance from the skin, (2) the same voltage setting was used as previously employed, and (3) an endeavor was made to obtain the same reading on the so-called high frequency milliampere meter, which is a more or less arbitrary scale. In the beginning we attempted to determine the exact number of watts actually required for each treatment. A milliameter was put in the plate circuit of the apparatus which thus indicated the current absorbed for actuating the oscillation. The milliamperes used by the patient were determined by first noting the number of milliamperes on the meter with the patient in the short wave field. The patient was then removed from the field and the drop in the milliampere reading was taken to constitute the number of milliamperes used by the patient. This number was multiplied by the number of volts (from the voltage setting) used and the result calculated in watts.

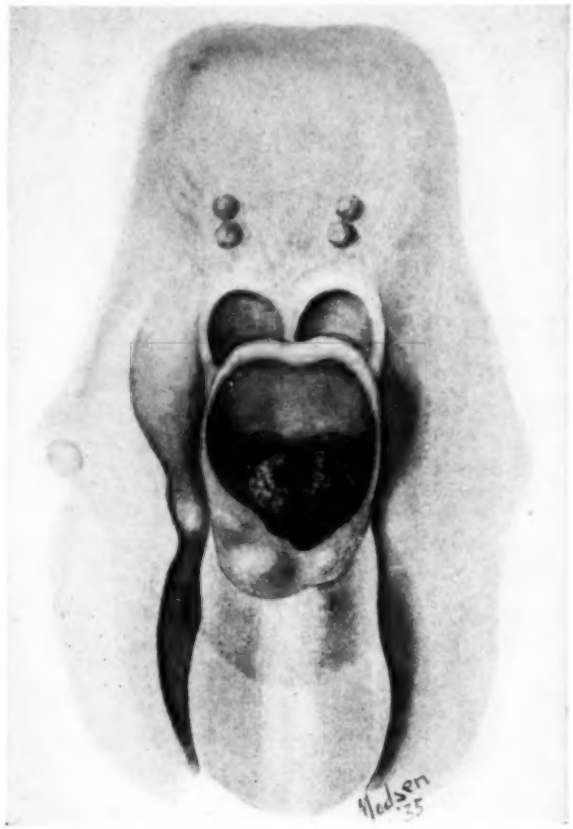

Fig. 1. Case 1. J. K., aged sixty-eight years; generalized laryngeal carcinoma, extrinsic and intrinsic. Received 30 *x*-ray treatments, divided into 2 treatments daily, right and left; total of 3000 *r* to each side. Treatment combined with short wave therapy.

While this procedure gave some definite expression of the dosage, yet as far as duplication of the dosage was concerned, we found that we were able to obtain fairly identical conditions by adhering to the procedure first mentioned, measuring the air distance, etc. In every case we tried to avoid raising the temperature of the part treated, both by keeping the air space between the electrode and the skin fairly wide, and by limiting ourselves as much as possible to the lower voltage settings. The usual length of each treatment was fifteen minutes.

These ultra-short wave treatments were combined with the Coutard technique of roentgenotherapy. The short wave treatments were given either shortly before or

in between the two halves of a daily *x*-ray dose. The patient's general condition was checked by frequent blood counts and physical examinations. We also attempted to keep a check on the progress of treatments by doing Vernes'[23] flocculation tests for malignancy.*

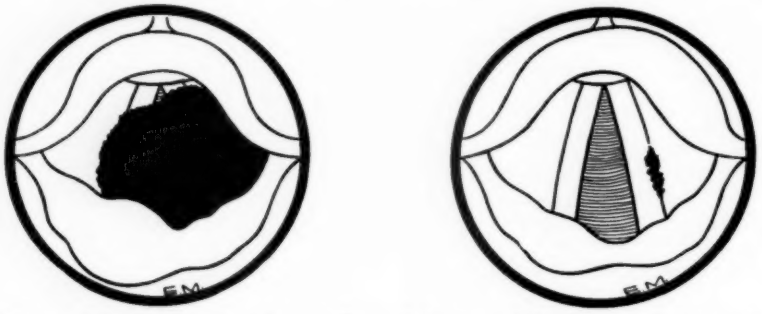

FIG. 2. Case 1. Examination one month later; epiglottis much freer and movable but much thicker on its left half; right side of epiglottis still thick but movable. The vocal cords are more pliable, the left still presenting some cauliflower appearance and thicker than the right side. The right cord is normal.

Subsequent history—patient is gaining weight, feeling well and voice is normal.

CASE REPORTS

During the last year 30 cases of malignancy were treated with the combined techniques of Coutard and the ultra-short waves. For our observations different localizations of the malignancy were selected: carcinoma of the oral cavity, of the larynx, of the epigastrium, of the uterus, and of the rectum. These cases may be divided into two series, (1) those of the radiosensitive and (2) those of the radioresistant type of tumor. In addition to these, there were 4 postoperative cases, in which the tumors were removed by surgery but suppuration of the incision resisted ordinary means of treatment.

FIRST SERIES: RADIOSENSITIVE TUMORS

CASE 1. J. K., aged sixty-eight years, male, had always been in good health previous to the onset of hoarseness and hemoptysis, occurring about one week prior to the examination in November, 1935. Laryngoscopy revealed a generalized laryngeal carcinoma, combined extrinsic and intrinsic, with a free pedunculated mass, about 2 cm in diameter, arising from the left vocal cord and extending to the right cord. It was dark brown and somewhat cauliflower in appearance with a few ulcerations in its mesial surface and formed a shelf-like area in the posterior portion of the larynx. There was considerable edema associated with the tissue swelling (Fig. 1).

The patient received a total of 6000 *r* in fifteen sittings over a period of six weeks, 200 *r* over each of the two fields with 1 mm. Cu. + 2 mm. Al., at 50 cm. distance. Ultra-short wave treatments were given before and in-between the two halves of the daily dose of *x*-rays.

Laryngoscopy after four weeks of combined treatment revealed considerable improvement. The epiglottis was much freer and more movable, and the vocal cords were more pliable. The left cord still presented some cauliflower appearance but the right cord was decidedly more normal. The patient's general condition was satisfactory, a gain of several pounds having been recorded (Fig. 2).

The combined course of therapy was followed by several treatments of short wave alone. Examination three months later demonstrated the disappearance of the mass, though some impairment of movement on both sides still remained. Hoarseness became much less pronounced.

Remarks. Biopsy revealed a radiosensitive epidermoid carcinoma, Grade III, which responds with good results with the

*The Vernes' flocculation test for malignancy is a serum flocculation test. Various dilutions of copper acetate are used and the flocculation value is determined by means of a special photometer.

Coutard technique alone. Prior to the treatment there was considerable edema of the larynx, nevertheless, the combined treatment did not increase the edematous condition. There was distinct, deep burning of the skin but no peeling occurred, nor any necrosis of the cartilage observed.

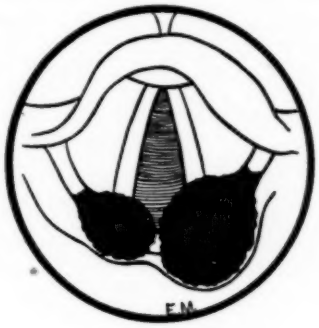

Fig. 3.

Fig. 4.

Fig. 3. Case II. W. B., aged sixty-six years; squamous cell carcinoma of larynx, Grade 1. December, 1935 the lesion is located in the region of the left arytenoid and extends to the left ary-epiglottic and glosso-epiglottic folds, and downward on the posterior surface of the larynx into the cricoid region where there is a large ulceration. The left cord is partially concealed by the growth. There is some infiltration of the left vallecula.

Received 30 *x*-ray treatments, divided into 2 daily treatments of 200 *r* each combined with short wave therapy.

Fig. 4. May, 1936, the patient gained weight and his speech is normal. There is thickening and irregularity with scar formation of the anterior epiglottis; there is thickening of the left posterior epiglottis. The vocal cords appear normal.

Case II. W. B., aged sixty-six years, male, complained of hoarseness and cough for about a year. Examination of his throat in January, 1936 showed a lesion located in the region of the left arytenoid, 2.5 cm in diameter, and extending to the left epiglottic field and extended downward on the posterior surface of the larynx into the crycoid region, at which point there was a large ulceration. The left cord was partially concealed by the growth. There was also some infiltration of the left vallecula. While the lesion extended to the right side the main infiltration was located in the left pyriform sinus (Fig. 3). No lymph nodes were palpable in the neck. The pathological report of the biopsy was cornifying carcinoma Grade 1 in Broder's classification.

The patient was treated by the combined technique and received a total of 7200 *r* of radiotherapy, 3600 *r* on each side.

Examination four weeks after starting the treatments showed considerable regression in neoformation, except for a small greyish area at the left epiglottic border with some discharge from a crater-like lesion and which elevated the left cord slightly.

A reexamination four weeks later showed further regression in the growth, except for a very small area at the left epiglottic border which showed a grey membrane, apparently the remains of the irradiation effect rather than the remnant of cancerous growth. Laryngoscopy in June, 1936 revealed no evidence of malignancy, the vocal cords appeared normal, though some thickening still remained on the left of epiglottis (Fig. 4).

Remarks. This case is similar to the preceding one, the tumor being of the radiosensitive type. In general, the patient went through the treatment much more easily than did the patient in Case 1.

In considering the cases of the radiosensitive type of tumor, the combined treatments showed no disadvantage over the Coutard technique alone. However, the skin irritation appeared to be less pronounced in the combined therapy.

SECOND SERIES: RADIORESISTANT TUMORS

Case III. J. B., aged sixty-four years, male, had an exploratory gastrostomy performed in

May, 1935 which revealed a diffuse induration on the lesser curvature of the stomach at the cardia, extending well into the esophagus, and involved the contiguous two-thirds of the posterior wall and the proximal third of the anterior wall. At that time it was diagnosed as inoperable carcinoma of the cardia of the linitis plastica type. Roentgenograms taken in November, 1935 revealed considerable proliferation of malignancy which had now affected the upper third of the greater curvature (Fig. 5). The patient had been suffering from stubborn pain which could be relieved only by opiates.

FIG. 5. Case III. J. B., aged sixty-four years; diffuse induration of the lesser curvature of the stomach at the cardia in November, 1935.

FIG. 6. Case III. June, 1936 after irradiation and ultra-short wave treatments.

In February, 1936 the combined technique of roentgenotherapy and ultra-short waves were instituted. The patient felt much better after four weeks of treatment, the pain gradually decreasing in severity. The total dose received was 7800 *r*, divided over the anterior, posterior and lateral fields, with a distance of 70 cm.

Roentgenographic reexamination of the patient June 16, 1936, revealed considerable improvement in size and outline of the stomach. There was no evidence of irregularity in peristalsis, with the exception of a moderate retardation at the cardiac end. The patient has gained eight pounds but complains of occasional spastic pain in the epigastric area, after any intemperance in his dietary regime (Fig. 6).

Remarks. It is premature to state anything about the results of the treatment in this case. However, considering that less than 10 per cent of gastric carcinoma is of the radiosensitive type, and that this case is not a radiosensitive type of tumor, and in addition being in an advanced state, the improvement merits attention. In this case also, it was noted that the pronounced skin reaction which usually is manifested at 3000 *r*, appeared diminished (Pack and Scharnagel[24]).

CASE IV. E. H., aged sixty-eight years, female, had been complaining of pain in the epigastric region and of a loss of 20 pounds weight during the six weeks prior to her admission in November, 1935. Physical examination revealed a flat mass, 11 cm. in diameter, occupying the epigastric area, its upper border 2.5 cm. above the umbilicus. Radiologic examination showed a large constant filling defect chiefly along the lesser curvature and posterior aspect of the pars media and pylorica of the stomach, giving the typical appearance of an adenocarcinoma (Fig. 7).

The patient was treated by the combined therapy, receiving 1200 *r* of *x*-ray radiation over each of two fields within a period of eight days. A second cycle of 1800 *r* was administered in

March, 1936, over each three fields within two weeks.

Re-examination in March revealed an almost normal appearance of the outline of the lesser curvature with the exception of a sluggish peristalsis (Fig. 8).

Fig. 7. Case iv. E. H., aged sixty-eight years; radiological examination, November, 1935, shows constant filling defect along the lesser curvature and posterior aspect of the pars media and pylorica of the stomach.

Fig. 8. Case iv. March, 1936 following treatment with combined roentgenotherapy and short wave.

At present the patient appears to be in good condition, has no complaints, and has gained seven pounds in weight. The treatments were given in divided doses, twice daily, short wave treatments given in between the *x*-ray therapy. The treatments were well tolerated with exception of an occasional mild nausea. The skin reaction appeared to be diminished in its intensity.

Remarks. The results in this case are interesting, considering the radioresistance of the gastric adenocarcinoma. However, it is too premature to draw any conclusions.

Case v. S. W. aged forty-four years, male, was admitted for treatments in April, 1936. The onset of disease dated back six months with nausea and vomiting, and of loss of weight and of appetite during this period.

X-ray examination revealed a dilatation forming a pouch in the middle third of the esophagus, which was caused by an obstruction of the cardio-esophageal junction, and permitted only a sluggish passage of the barium meal. Esophogoscopy revealed that at the base of the esophagus there was an irregular, whitish, cauliflower-like appearance of the mucosa of carcinomatous origin.

Combined technique was applied. *X*-rays were given over three fields each totalling 3000 *r*, in two daily treatments of 200 *r* to each field. The short waves were applied in the interval between the two treatments. The skin tolerance was found to be markedly increased.

Considering the very high dosage administered, the nausea was noted to be less than one would ordinarily expect under these conditions.

Radiological examination in July revealed a widening of the upper portion of esophagus and sluggish peristalsis. At the lower third, the cardiac end passage was reduced to one-third of the normal width, but the meal passed without any obstruction or spastic reaction. The patient is still under treatment.

Case vi. E. R., aged fifty-two years, female, has a history of cancer in the family. She had been complaining of a severe pain and rectal bleeding. *X*-ray examination in November, 1935, showed small circumscribed round shad-

ows scattered along the wall of the rectum and of the sigmoid, extending upward along the descending colon. Physical examination Decem-

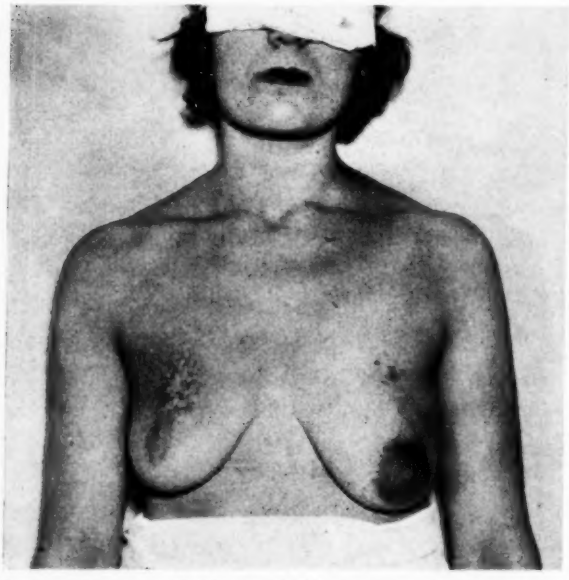

Fig. 9. Case vii. J. F., aged thirty-seven years; mammary carcinoma of both breasts. Postoperative healing progressed under short wave treatment.

ber 5, 1935, revealed a narrowing of the rectum about 4 cm. from the external canal which extended for a distance of about 4 cm. There was an indurated mass, polypoid in character, forming a distinct ridge. Diagnosis of carcinoma of the rectum, epithelioma of prismatico-cellular type, was made.

Combined treatments of *x*-ray therapy and ultra-short waves were begun on December 5, 1935. *X*-ray treatments, given over four pelvic fields, totalled 6000 *r*.

By January 14, 1936, the patient's condition seemed to be greatly improved, the pain had diminished and additional radium was implanted into the posterior wall of the rectum, totalling 2525 mghrs.

An examination March 30 revealed no palpable induration, and the patient's general condition was satisfactory. A re-examination in June, 1936 showed no change.

Remarks. Generally, carcinoma of the rectum does not give very satisfactory results with radiotherapy. Gordon-Watson[25] recommends surgical intervention for such cases. However, he reports a few inoperable cases of carcinoma of the rectum treated with satisfactory results by the Coutard technique. Tailhefer[26] emphasizes the difficulties with radiotherapy of the rectum and the uncertainty of results. In this case it seemed that the tumor did not offer much resistance to the combined treatment. However, only time and repeated re-examinations of the patient, can show whether the results of this combined technique are of value in the treatment of malignancies of the rectum.

In radioresistant tumors, the combined technique offers some advantage over the Coutard technique alone, however, it is still too early to make any definite conclusion in this regard.

POSTOPERATIVE CASES

Case vii. J. F., aged thirty-seven years, female, presented the following past history. In 1927 the right breast showed a palpable tumor 3 by 5 cm. Biopsy substantiated the diagnosis of carcinoma of the right breast. The patient was treated with *x*-ray therapy and radium and a complete disintegration of the tumor followed. Periodical examinations up to 1932 showed no recurrence.

However, in 1934 the patient returned, having noted a lump in her left breast. Examination revealed a tumefaction in the left breast, 6.5 cm. in diameter, at about 2 o'clock from the nipple. Pathological report by Dr. Ewing was that of carcinoma. Endocrine findings on the patient, were: "Ovarian hormone curve is within normal limits, prolan curve is slightly and continuously high."

Radium application and *x*-ray therapy were instituted. The patient received a total of 1800 *r*, divided over four fields, and radium implantation totalling 3360 mghrs. and in September, 1935, the remaining mass was excised. The specimen was oval shaped, 5 cm. in length, 3.5 cm. in width, with a depth of about 4 cm., and consisted of fibrotic tissue. The area around this mass did not appear diseased, nor were any tumefactions palpable. Pathological report of the specimen was negative for malignancy.

Suppuration from the incision persisted for three months, notwithstanding insertions of drains and frequent irrigations. In December, 1935 ultra-short wave treatments were begun, being applied three times a week for fifteen minutes. Healing progressed and was practically complete by the end of February (Fig. 9).

The patient was discharged and advised to present herself for periodical examinations.

Remarks. This case is presented to demonstrate the value of ultra-short wave treatments in postoperative healing.

Case VIII. H. S., aged forty-two years, female, had a history of having a lump in the region of the left parotid since childhood. Father of the patient died of cancer of the throat. In 1933 the growth increased in size and a parotidectomy was done in August of that year. The tumefaction was flattened in contour and about 1 cm. thick. Pathological report revealed an "infiltrating carcinoma with prominent glandular feature." In February, 1935, a recurrence of the tumor was noted and the patient underwent a second operation in May, 1935. Radium implantation totalling 2000 mghrs, and *x*-ray treatments totalling 2000 *r*, were given postoperatively. Diathermy was also applied to decrease the pain, but without much success.

A persistent discharge from the incision and a continuous pain in the region, led to starting a series of ultra-short wave treatments, beginning December 12, 1935. By January 15, 1936, after ten treatments of fifteen minutes each, the wound had completely healed. However, after stopping the treatments for one month, the patient returned claiming that she had less pain while she was receiving the treatments. At the present time, an occasional treatment is given, and the patient's condition is satisfactory.

Remarks. This case demonstrated the analgesic effect of the ultra-short waves.

DISCUSSION

Radiosensitivity of cancer cells cannot be considered as constant at all times. It varies in relation to the physiological condition of the cells which exist at the time of irradiation. Crabtree and Cramer[27] have shown that radiosensitivity is not a fixed property of malignant cells, but varies with the changes in environment. It is evident that in the light of these findings, the question as to the exact phase in which the cells are most sensitive to irradiation begins to lose some of its reality.

Susceptibility of the dividing cells depends on the physiological state of mitosis which offers a more favorable condition for ionization, which, according to Lind[28] is the initial cause for the chemical reactions which are set up by radiation. The problem, precisely which cellular phase is the most sensitive, whether metaphase, telophase, or prophase, is of little practical value.

It seems to be a rule that those cancer cells of the embryonic type, which have a considerably high (1:3) nucleoprotoplasmic ratio are the most radiosensitive. It is known that tumors showing a high degree of anaplasia and forming diffuse infiltrating growth are composed of such cells. The tumors in which the cells are of the adult type with the N-P ratio approaching that of normal adult cells (1:6) have the tendency to keratinization and are the most resistant to irradiation. So that from the cytological point of view, it may be possible to say that a high N-P ratio of cells is an indication of their susceptibility to irradiation (Sokoloff[29]).

But dealing with tumors, one might find other factors involved, which sometimes interfere with cellular susceptibility, the importance of which has already been recognized by some radiotherapists. If we admit that sensitivity to irradiation is increased when there exists a rapid increase in respiratory metabolism,[30] we are justified in making an attempt to increase the metabolism in neoplastic tissue before and during the irradiation. One of the means of increasing respiratory metabolism is by augmenting the blood supply through hyperemia and vasodilation. In this sense, ultra-short wave offers a convenient and simple technique. Wherever there was a possibility of a direct observation of the treated tumor, as in larynx patients, a pronounced hyperemia of the tumor itself was noted from the first days of the short wave treatments. This hyperemia has never been observed to such a degree in patients treated by roentgenotherapy alone.

However, the ultimate effect of radiation depends on the power of recovery of

the cells, which in its turn depends on the blood supply. This fact, of prime practical importance, is often neglected by laboratory investigators, who arrive at a generalized conclusion from their experiments in vitro.

Thus the experiments with chick embryos show that the effects in vivo are not exactly similar to those obtained in vitro. The response to radiation varies according to the presence or absence of a blood supply (Spear[31]). When the blood supply is normal, recovery is favored, but if the blood vessels are injured by irradiation, a generalized destruction follows. This is demonstrated by the experiments of Strangeways and Fell in cases of chick embryos. If the embryos are irradiated before the blood vessels have appeared, they are capable of tolerating much greater doses of radiation than after the vascular system is developed.

There are also indications that endothelial and subendothelial tissues are highly sensitive to irradiation (Colwell[32]), which probably plays a considerable role in the destructive effect of irradiation on vessels of the tumor. In this sense, this effect of short waves may facilitate the obliteration of blood vessels of the tumor by *x*-rays. Pflomm was able to demonstrate this effect by obtaining a complete temporary stoppage of the blood stream in the smallest veins and in the capillaries of frogs by using ultra-short waves of 4 meter length. Continuance of action produced thrombosis. Naturally, in the small doses that are used in practice, this effect is not to be expected in the short treatments used, but it is possible that the combined effect of short waves and of *x*-rays may produce a more damaging effect on the tumor.

In the limited space of time which has elapsed from the start of our investigations, we cannot as yet form any definite conclusions concerning the increase of radiosensitivity of the tumors treated by the combined technique. However, observing some 30 cases for a period of one year, our impressions are that the method is of value. In our experience there has been no case whose condition was aggravated by the combined treatment. It has been noted that skin injury from irradiation seems to be decreased when short waves are used in conjunction with the irradiation, but again, no definite claim can be made until more patients have been observed.

CONCLUSIONS

1. Combined treatment of Coutard technique of roentgenotherapy and ultra-short wave (6 meter length) has been applied to 30 cases of malignancy, avoiding as much as possible the thermal effect of the short wave.

2. There was no indication that ultra-short waves aggravated or stimulated neoplastic tissue in any of the cases.

3. It is premature to draw any definite conclusions as to whether the vasodilatory action of these ultra-short waves increases the radiosensitivity of the tumor.

4. Lessening of skin injury by *x*-rays was observed in some of the patients, but more studies must be made in order to draw any definite conclusions.

5. Short waves were found to be of distinct benefit in postoperative suppurations.

6. Analgesic effect was obtained in some cases when treated by ultra-short waves.

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It seems that infections of the pancreas occur more frequently than cysts or neoplasms. Carcinoma is the most common of the new growths. In 11,472 necropsies, Segre found 127 cases of carcinoma and two of sarcoma. Hale White found one case of sarcoma in 6708 necropsies. According to Deaver and Pfeiffer, carcinoma is the most frequent tumor of the pancreas, forming one per cent of all cases of carcinoma. The secondary are more frequent than the primary, coming from the stomach or biliary passages—10 per cent of gastric carcinoma extending to the pancreas—while the most common benign tumor is the cystadenoma.

Papers on Surgery and Other Subjects by George Tully Vaughan, M.D.

NEW INSTRUMENTS

A NEW INSTRUMENT AND TECHNIQUE FOR INTESTINAL ANASTOMOSES*

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KEARNY, N. J.

SOME years ago after an unfortunate and unsuccessful attempt to anastomose the ileum to the ascending colon for relief of an obstruction at the ileocecal valve, we became dissatisfied with the conventional type of intestional clamp. We therefore embarked upon a series of mechanical and surgical experiments which after a long course of trials and errors resulted in the instrument and technique to be described.

Reduced to its simplest requirements the solution of this problem required an exhaustive study of the mechanical efficiencies of only two basic types of instruments.

1. The present type of two blade clamp with alterations in the length, breadth, flexibility of the blades as well as changes in the distance from the screw to the ratchet catch, the number and fineness of the teeth in the catch, all factors which determine how well or how ill the clamp will hold;

2. An adjustable tension device with mechanical fingers containing rubber inserts which grasp and hold the anastomosis under any predetermined and reasonable degree of tension compatible with easy and accurate suturing.

We secured a half dozen modifications of the conventional type long intestinal clamp. All possible modifications of the length, breadth and flexibility of the blades with respect to the position of the screw and catch were included in the designs. Using these clamps for our experiments we performed a considerable number of posterior gastroenterostomies on dogs. Briefly stated, we found that within certain mechanical and surgical requirements and limitations, it is very difficult, almost impossible, to perfect a clamp which will exert a uniform non-traumatic grasp on the loops of bowel about to be joined together. Or, to state this conclusion in other words, no matter how one alters the conventional type clamp, with respect to the factors given, the total effect is that of a shearing force no different in its fundamental principle than that exerted by a pair of scissors. The segment of bowel nearest the screw, or fulcrum, will be firmly held, let us say almost crushed, while the outer portion may be so loosely grasped that it slips.

As the experimental and practical evidence was accumulated it was found necessary to establish some standards against which our results should be compared. After careful consideration and analysis of the problem, the following four factors were used as a basis upon which to evaluate the results.

1. *The Mechanical Efficiency Factor.* The instrument must be light and strong, as small as possible, simple in construction, neat, and with a regulating pressure device for holding the clamp (Fig. 1).

2. *The Physiological Factor.* The application of the clamp, or device, must reduce to a minimum the interference with the blood supply, the lymphatics, the nerves, and the intrinsic nerve plexuses of Auerbach and Meissner.

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3. *The Surgical Adaptability Factor.* Easy hemostasis through clamp and ligatures and neat approximation of the cut stomach is approached through a high left rectus incision. The desired folds of the stomach and jejunum are grasped with

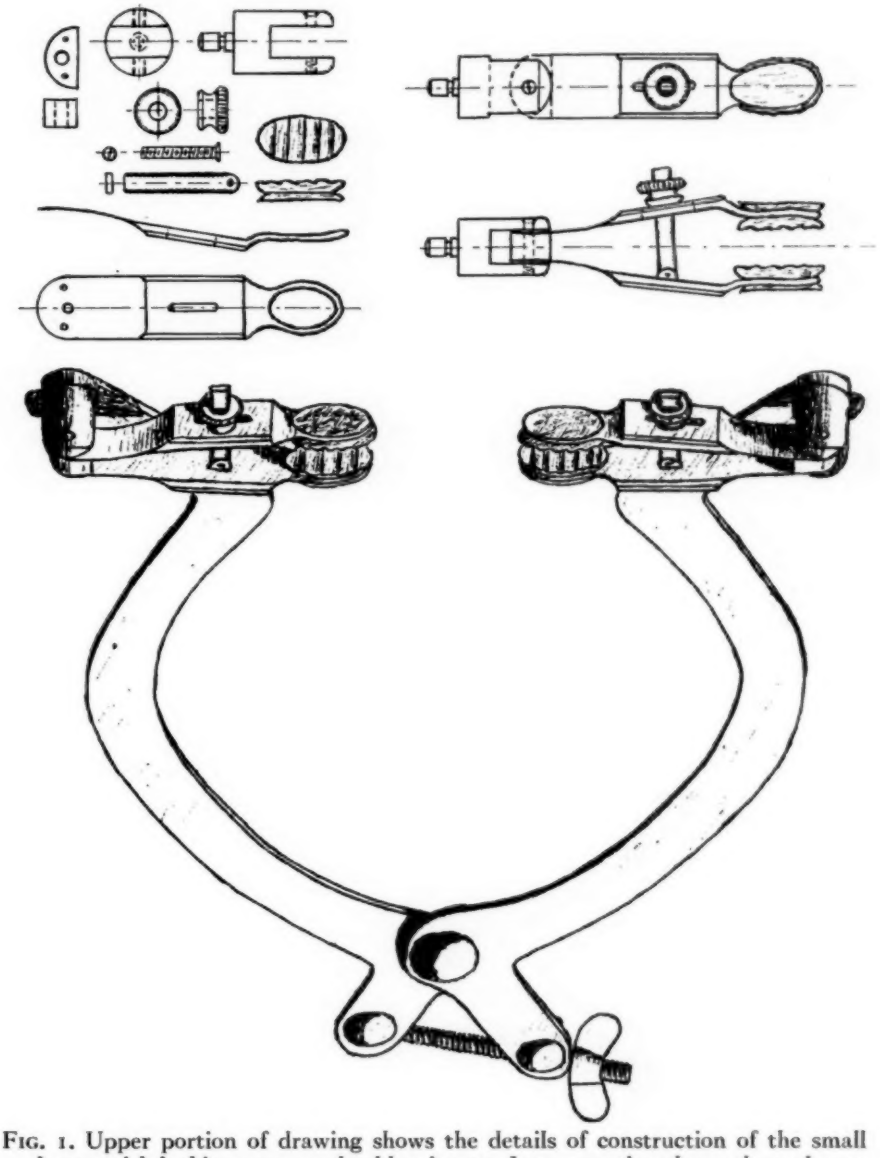

FIG. 1. Upper portion of drawing shows the details of construction of the small clamps with locking screw and rubber inserts. Lower portion shows these clamps secured in the large tension device.

surface of the bowel through careful suturing.

4. *The Bacteriological Factor.* Extraperitonealization through the use of rubber sheeting.

The application of this instrument and technique is described in detail using the gastroenterostomy as a typical type of enteroenterostomy (Fig. 1). The abdomen is prepared in the usual manner. The Allis tissue clamps placed about 5 inches apart. A piece of rubber dam tissue, which is approximately 12 inches wide by 18 inches long is laid over the stomach and the long edge is applied to the fold of the stomach and held by Allis clamps (Fig. 2). The same procedure is done with the jejunum. Next the special, small intestinal clamps are fastened to the edges of the future anastomosis in the following manner.

The clamp is picked up in the right hand and at the same time the two loops of the bowel, with the rubber tissue sheeting, are by turning the thumb screw with the thumb and forefinger of the right hand until the clamp is held firmly in place (Fig. 3).

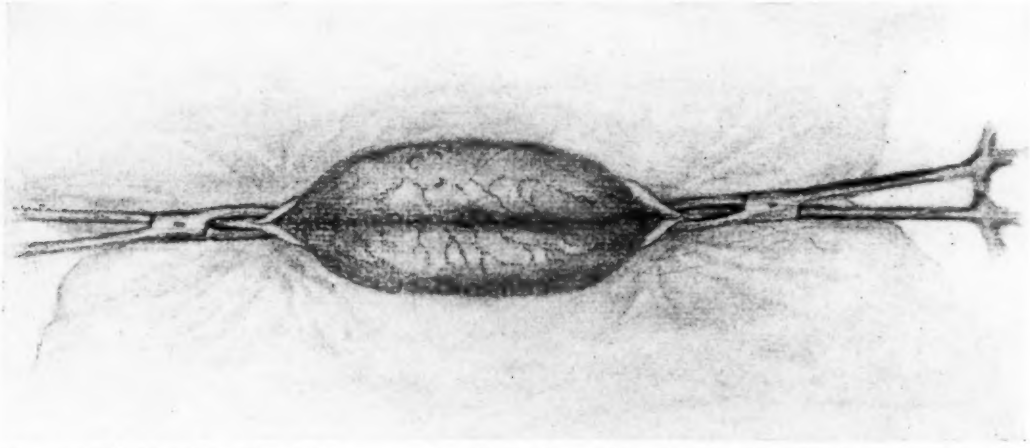

FIG. 2. This drawing shows the manner in which the rubber sheeting is applied against the sides of the bowel and temporarily held by Allis tissue clamps.

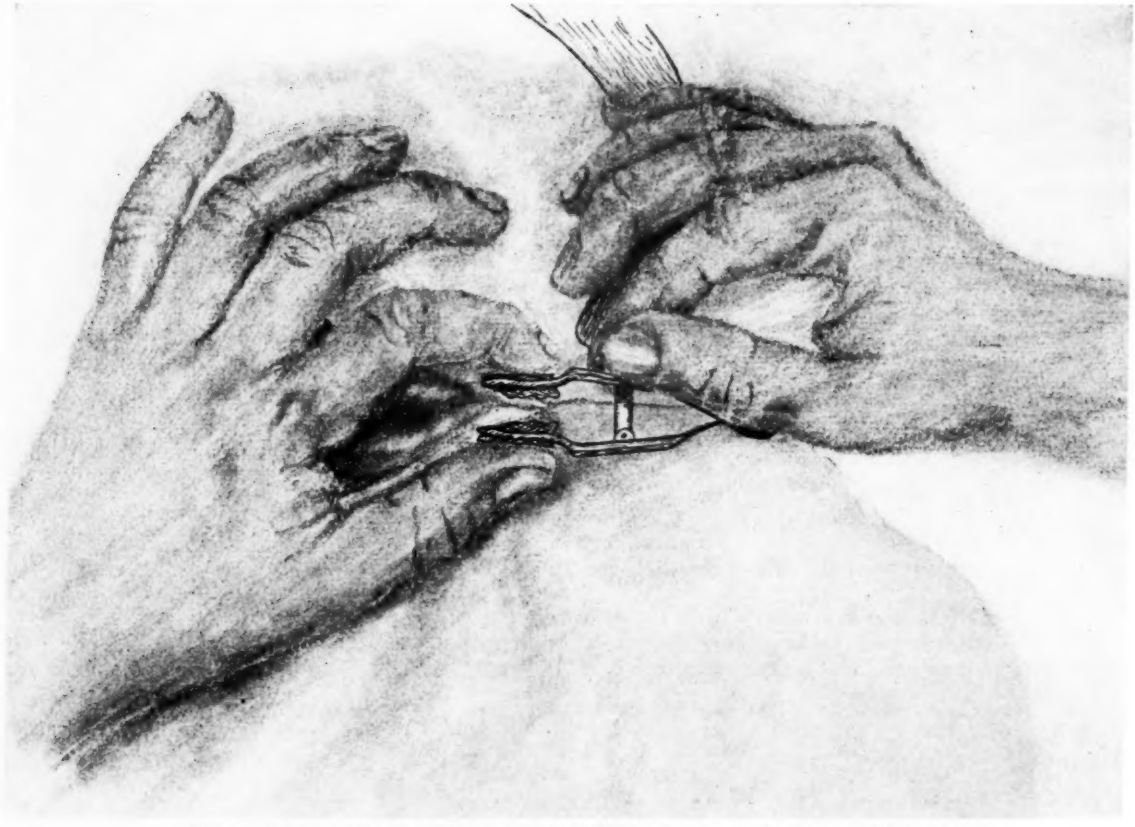

FIG. 3. The application of the small holding clamp to the loops of bowel.

picked up by the thumb and forefinger of the left hand and held firmly. The clamp is then pressed down on the bowel and held securely by the forefinger and thumb of the left hand. Pressure is then exerted In this fashion the future anastomosis is joined together in the manner in which it will be sutured. The Allis tissue clamps are then removed. The clamps are now set in the tension device and fastened by

set screws. The proper amount of tension is exerted on the clamp by turning the thumb screw on the threaded bolt on the lower part of the large tension device. In this manner the anastomosis is put under tension for easy suturing, at the same time the application of tension in the two folds of bowel smoothens out the mucous membrane within and creates a sphincter-like action. This tension limits the amount of intestinal contents that may escape upon the rubber tissue applied against the folds of the anastomosis and forms a water-tight protection against contamination of the general peritoneal cavity. The two loops of bowel are now held firmly together and the posterior continuous peritoneal suture is applied (Fig. 4). The stomach is incised along the edge of the fold directly through it and into the lumen. The active bleeding from arteries and large veins is controlled by clamp and ligature. The same procedure is repeated with the jejunum.

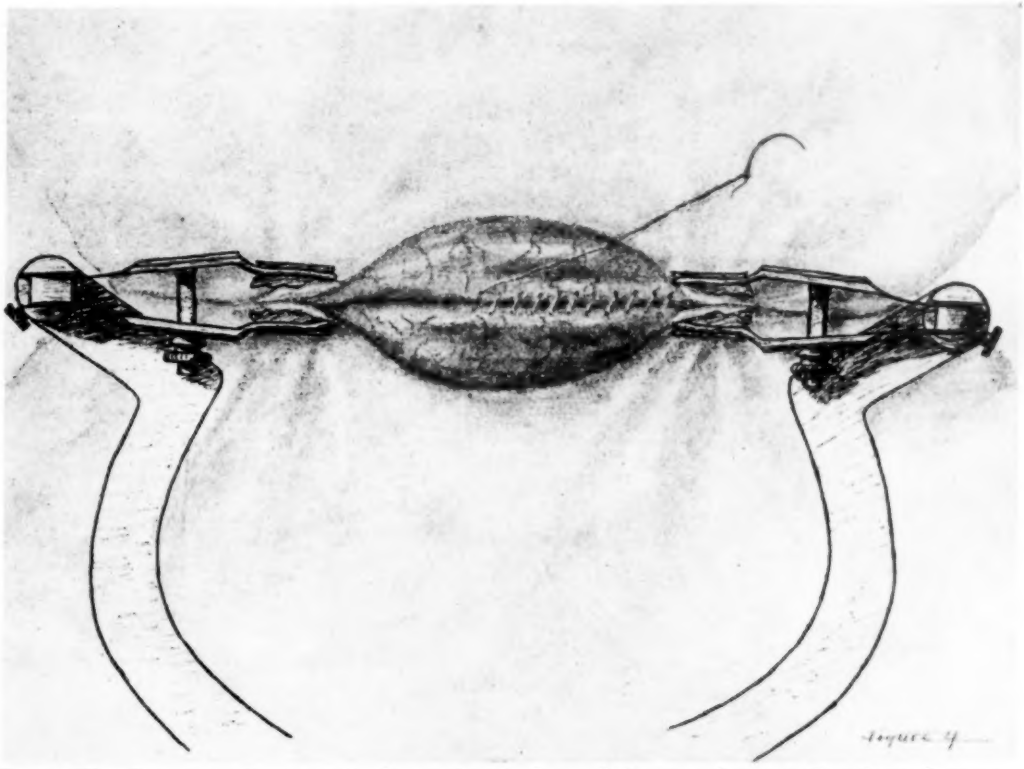

Fig. 4. The clamps are shown set in the tension device and the posterior row of peritoneal sutures being inserted.

Next the seromuscular stitch is applied (Fig. 5). The particular feature of this device is that it enables one to turn the corners of the seromuscular layer with neatness and in a very water-tight manner, simply by releasing the large tension clamp on the anastomosis while the corner is being turned. The seromuscular stitch is completed in the usual manner and then the anterior peritoneal row of sutures is finished. This completes the anastomosis. The loops of bowel may be wiped off with a mild aqueous solution of merthiolate. The gloves are changed, the clamps are removed, and the rubber sheeting carefully lifted away. The abdomen may then be closed in layers in the usual manner without drainage. The general principles involved in anastomosing two loops of bowel together as outlined may be applied to any type of intestinal side-tracking procedure which may be desired.

In dealing with the obstructive lesions of the gastrointestinal tract due to car-

cinoma, adhesions, hernia, volvulus and intersussception is which a resection must of necessity procede the anastomosis the technique is modified in the following manner.

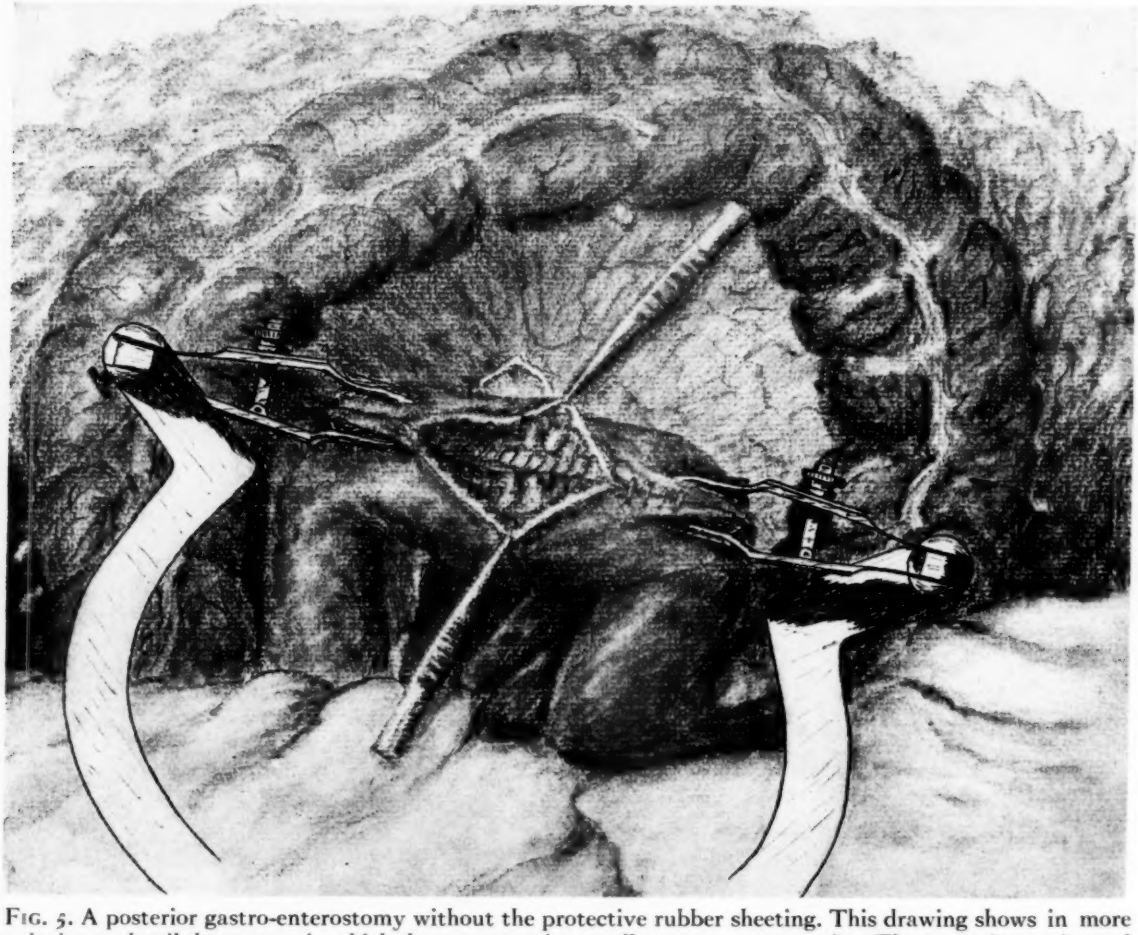

FIG. 5. A posterior gastro-enterostomy without the protective rubber sheeting. This drawing shows in more intimate detail the manner in which the anastomosis actually appears at operation. The posterior peritoneal and sero-muscular sutures have been inserted and one-half of anterior row is finished.

The segment of diseased bowel is removed in the usual manner. Before removing the clamps on the severed edges of bowel the intestinal contents are aspirated through a medium size trochar inserted into the free edge of the bowel at that point which will be approximately the middle of the anastomosis. The ends are closed over and the isomesenteric edges of the bowel are laid together and joined as described. As an alternative method to prevent the intestinal contents from escaping, we cut off the sharp points on a tonsil thumb forceps, threaded the sides with rubber tubing and clamp this forceps on the proximal loop of bowel about 5 inches above the anastomosis.

DISCUSSION AND CONCLUSION

The careful consideration of the text and pictures will show that this method offers a better procedure than that done with the conventional type of clamp for the following reasons:

An anastomosis may be accomplished rapidly with the minimum amount of surgical shock and trauma to the patient. The control of the bleeding is taken care of primarily, thus, avoiding the danger of secondary hemorrhage. The anastomosis heals more rapidly because of the minimum amount of interference with the natural physiological functions of the intestines,

thus avoiding the dangers of secondary sloughs. Healing is promoted by first intention through accurate and firm approximation of the tissues. The general peritoneal cavity is protected from infection by a tight, elastic, waterproof membrane which prevents leakage of infected material into the general peritoneal cavity.

Due to its great flexibility an intestinal anastomosis may easily be accomplished with this instrument within the abdominal cavity itself when it is difficult or impossible to mobilize one or both loops of bowel. This advantage not only permits the surgeon a greater refinement in his technique in this trying situation but also assures the patient a greater margin of safety from the usual complications which very often follow.

It is our personal opinion that secondary marginal ulcers following gastroenterostomy are due to the failure of securing at the time of operation a firm, uniform healing of the mucous membranes to themselves without defects. We feel that refinements in the technique for this operation will lower the percentage of this annoying complication and restore the gastroenterostomy for duodenal ulcer to its proper place in intestinal surgery.

In the diagnosis of cancer of the intestines the following points may be taken into consideration. In comparison with the subjects of malignant disease of the stomach very many of the patients are young. . . . Intestinal features are present in the majority of cases, though they were by no means suggestive in the patients who have been under our observation. Griping, colicky pains are common, even without the signs of obstruction. With narrowing of the lumen of the gut very characteristic features occur—attacks of severe griping pain, abdominal distention, and presence of active, sometimes visible peristalsis in the distended coils of bowel, and, if the condition persists, vomiting and all the signs of intestinal obstruction.

Osler's Lectures on the Diagnosis of Abdominal Tumors.

HEATER FOR INTRAVENOUS SOLUTIONS

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IF the temperature of a relatively large amount of fluid injected intravenously is below that of the blood, a certain amount of heat must be furnished by the body to warm the introduced liquid. Such loss of calories may not be objectionable in certain conditions, e.g. after thyroidectomies, when the patient is "burning up," but it certainly is undesirable in the majority of conditions requiring a venoclysis, such as collapse, postoperative shock or that following injuries, etc.

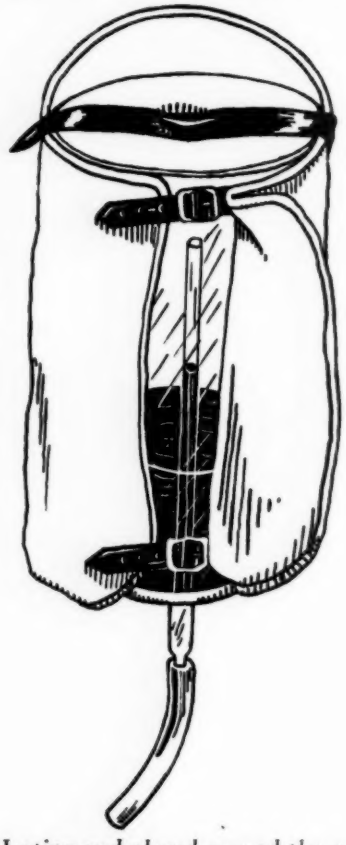

FIG. 1.—Heating pad placed around the container.

Many attempts have been made to maintain the injected fluid at a constant temperature, corresponding more or less to the temperature of the body. Hot water bottles placed around the container require refilling and their heating effect is not uniform as their shape is not adapted to the flask. Electric devices are contraindicated because a leakage is a potential danger and the wires interfere with free movements of the personnel. The flask may be placed in a larger container connected with a faucet and the temperature of the running water regulated. Such device is cumbersome and not every room is equipped with a water outlet.

It occurred to the writer that so-called chemical pads may serve as a simple expedient for this purpose. A suitable sized sac is selected so that it fits snugly around the flask, leaving sufficient space to observe the level of fluid. Two straps on the side and one over the bottom of the flask keep it in place. The sac is filled with a mixture of metal oxides or any other similar chemical compound available on the market and the addition of 20 c.c. of water produces heat of 170°F. within the sac. Repeated experiments showed that the temperature of the fluid dripping from the needle for intravenous use ranges from 92° to 100°, according to the amount of powder used. As the sac retains its temperature about ten hours, a uniform temperature of the fluid is secured. The sac can be cooled by removing it from its rubberized cloth wrapper. It can be used repeatedly as long as the life of the chemical compound lasts. The initial expense is minimal and it has been calculated that the cost of heating one liter of a solution does not exceed four cents.

SOME AIDS IN TREATMENT OF COMPOUND FRACTURES

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THE task of cutting a window in a cast for a compound fracture is usually left to a junior interne. The opening in the cast is usually made too small and has to be trimmed with a knife or scissors, resulting in fringed edges and plaster dust sprinkled into the wound. Occasionally, after the opening has been trimmed to the proper size, the attendant surgeon finds, to his great chagrin, that the fragments of bone, or in some cases the Lane plate has been displaced during the process and the patient has to be taken to the operating room again. When the opening in the cast is made too large, the value of its support is diminished.

Should an infection occur, the opening is often found filled to the rim with pus containing particles of plaster and shreds of gauze. Although the wound is dressed daily, or even oftener, the edges of the cast that are in direct contact with the wound become completely saturated with pus, soften to the consistency of a slough, and are a continual source of reinfection, besides failing to give the proper support.

To obviate these complications, the following device is suggested:

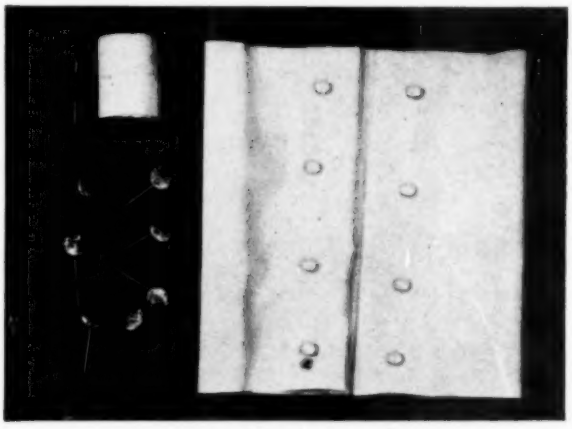

FIG. 1. Materials used.

The material used consists of four large pins with wide flat heads, the type used to pin automobile covers in place (they can be purchased for five cents), two narrow strips of adhesive, and a piece of rubber sheeting measuring about 8 by 12 inches

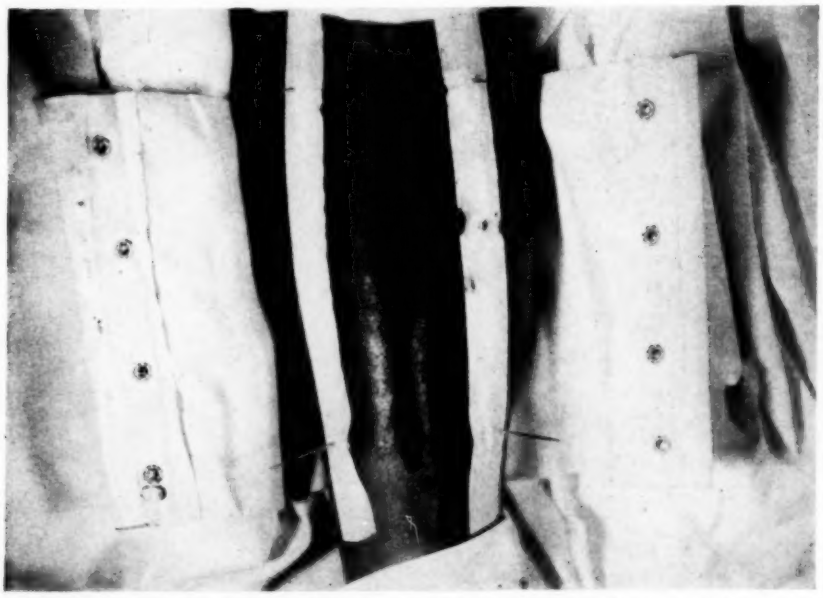

FIG. 2. Showing demarcation of wound with pins and adhesive, with corset in position.

(Fig. 1). The latter can be purchased in the Five and Ten Cent store.

Before applying the cast, the ends of the rubber sheeting are reinforced with a piece of cardboard and holes are punched through the edge in the same manner as in a postoperative corset. It is then placed behind the fractured limb. Two narrow strips of adhesive are cut to the size of the wound, a pin is put through the ends of each strip, and the adhesive is fastened along the margin of the wound (Fig. 2). The wound is then dressed, covered with the rubber sheeting which is laced with narrow tape. The cast is then applied. When the cast is completed, four pins are protruding from it, giving the surface markings of the wound (Fig. 3). When the window is cut out of the cast, the wound is ready for dressing and, if necessary, reinforcing with additional layers of gauze (Fig. 4).

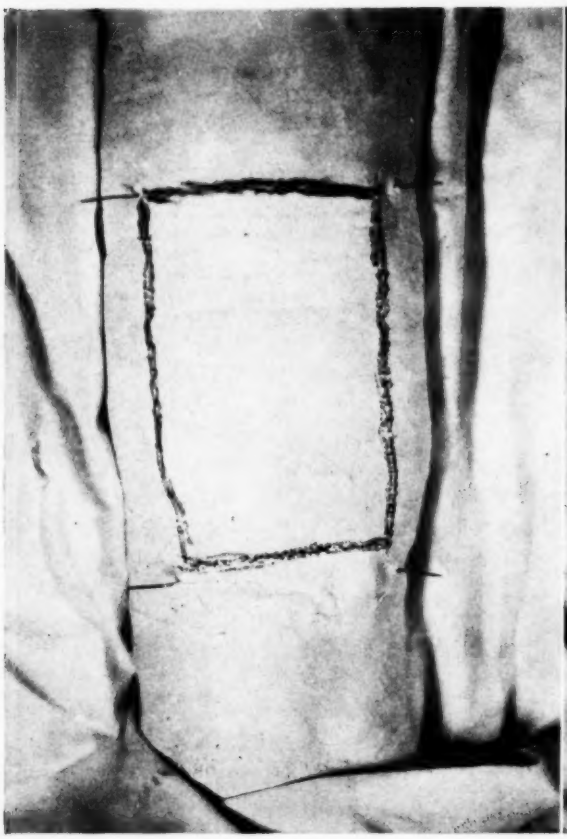

FIG. 3. Pins protruding, showing surface markings of wound after application of cast.

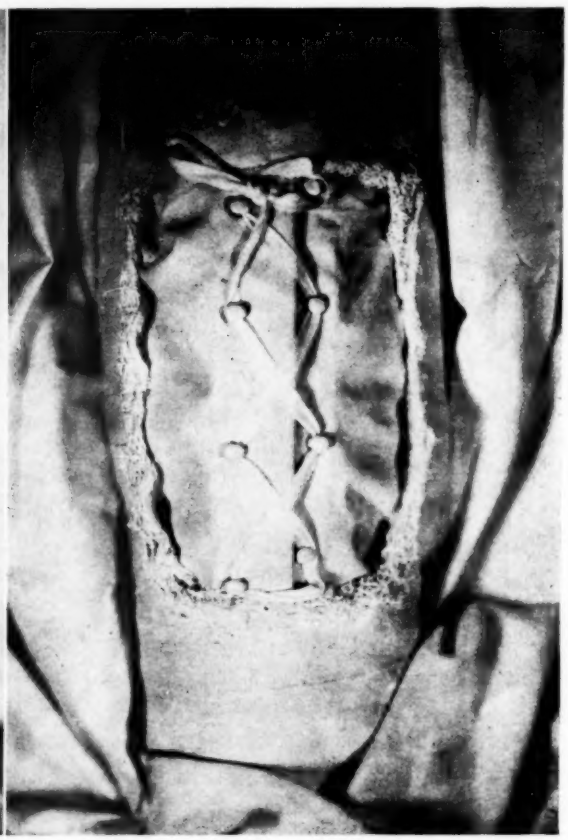

FIG. 4. Showing window cut out of cast and corset laced.

These adjuncts in the application of casts are not only useful in compound fractures, but can also be applied in cases of chronic osteomyelitis and malignant bone diseases that are associated with pathological fractures and necrosis, necessitating immobilization by casts and daily dressings.

SUMMARY

1. The cutting of a window in a cast for a compound fracture often involves additional trimming when the opening is made too small, sometimes resulting in displacing the fragments of bone and contaminating the wound with plaster dust, also leaving uneven, ravelled edges.

2. When infection occurs, these edges are saturated with pus and are a continuous source of reinfection, besides weakening the cast.

3. A device is suggested where four pins indicate the exact surface markings of the fracture, and a rubber corset around the fracture aids in dressing the wound and prevents reinfection.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

SKETCH OF THE EVOLUTION OF AMERICAN ORTHOPEDIC SURGERY*

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THE term "Orthopedic Surgery" first appeared in a book by Valentine Mott in 1841. He defined it as the combination of mechanical and operative surgery, which he predicted, was to "inaugurate a new era in the healing art."

This definition indicates clearly the remoteness of its connection in everything but name with the "Orthopédie" of Andry. For his book which bore this title, was concerned only with those defects and blemishes of childhood "which could not be concealed" and with such remedial measures as were at the command of parents and nurses.

The mechanical treatment of deformity was an old and established practice upon which operative surgery was an intrusion, and the question at issue was which was to be the dominant factor in the final amalgamation.

Those more immediately concerned in the controversy were four so-called pioneers, practicing in New York City in the latter half of the last century, James Knight, Henry G. Davis, C. Fayette Taylor and Lewis A. Sayre. The relative value of their contributions to the foundations of orthopedic surgery and their personal influence in shaping its development may be suggested by the following quotations from their writings.

Knight's primary interest was in hernia for which he devised an effective truss. "This," he states, "served as an incentive for the construction of appliances for the restoration of impaired powers of locomotion in children, and for the treatment of deformities resulting from constitutional impairment."

To provide the proper conditions, "we introduced the initiatory efforts in our own dwelling." The experiment was so satisfactory, that within a few years he succeeded in organizing the New York Society for the Relief of the Ruptured and Crippled. A model hospital was constructed in 1870, to which he transported his patients and his family, thus assuring the domestic quality of its predecessor, in which religious and secular instruction were essential factors, as also was bodily activity regardless of the condition of the patient. "No child able to hold up his head is ever kept in bed during the day, and all able to walk by pushing a chair before them, have thus

* Read before a joint meeting of the Philadelphia Orthopaedic Club and the Orthopaedic Section of the New York Academy of Medicine, at the Hospital for the Ruptured and Crippled, New York, November 17, 1933.

to exercise for a certain time; and those unable to walk from pain or tenderness are supplied with rolling chairs. Even the most vigorous constitution would be weakened and brought to a state of etiolation by long continued repose, and in a weak constitution the malady would be correspondingly increased."

Knight's system of treatment "by enforced hygiene, by nutritious dietary, by mechanical appliances to insure rest to an invaded joint," supplemented by tonic remedies of which mercury was an important constituent was very successful. For according to his report, "75 per cent of the ordinary conditioned patients, laboring under synovitic disease, were restored to self sustaining ability."

Knight described his practice as surgicomechanics, which as outlined in his book "The Orthopaedia" included in its scope all disabilities that might be treated by bandaging and bracing, even uterine displacements and hemorrhoids. He was absolutely opposed to surgical intervention and would have had "conservatism engraved over the entrance of the hospital" which he had founded.

Davis practiced "conservative surgery." This was defined in the introduction of his book, published in 1867 representing the experience of thirty years, by a quotation from Hippocrates, "As a mode of cure, and it requires neither cutting nor burning, nor any complex means."

The chief purpose of the book was to exploit constant elastic traction as a potent and comprehensive remedy for joint disease and deformity, "a field so fruitful that we could wish for another term of life than that alloted to man to enable us to continue these investigations."

He established what became known as the American treatment of hip disease, by constant elastic traction, which by permitting motion without friction assured nutrition and prevented anchylosis. In cases treated by his method "healing should occur without further erosion of the diseased surfaces and full motion will be restored."

Davis, like Knight was absolutely opposed to surgery. He "trusts that the time is not far distant, when intellectual efforts to preserve the human frame intact will be as humane and honorable, as is the devising of some new mode of mutilating it at the present time."

Taylor's primary interest was in physical culture, and for several years after his graduation in medicine he conducted a gymnasium. Failing to arrest the progressive deformity of Pott's disease by his attempts to improve the resistance of the dorsal muscles, he devised the "spinal assistant" and later other braces for the treatment of tuberculous disease of the joints. In order to demonstrate his methods, he, following Knight's example, founded the Orthopaedic Dispensary, and a ward in St. Luke's Hospital was placed at his disposal for the care of bedridden patients, but within a few years he confined his practice to his own institution. He supplemented mechanical treatment by corrective exercises, particularly by machines, of which he invented a large number.

Although Taylor "never wrote a prescription" nor a book, he was a more constant contributor to medical literature than his colleagues and on a wider range as is indicated by such titles as "Sensation and Pain, Emotional Prodigality" and the like.

Sayre, the representative of orthopedic surgery as defined by Mott, stood much higher in both the social and professional scale than the others of the group. He was a surgeon, a founder of the Bellevue Hospital Medical School and the first professor of orthopedic surgery in this country, including in his professional title, fractures, dislocations and clinical surgery. In 1876 he published a book entitled "Orthopedic Surgery and Diseases of the Joints," "in response to numerous letters from eminent men both here and abroad urging him to prepare a work setting forth his peculiar views on pathology and treatment."

The book was based on his lectures and, as contrasted with "The Orthopaedia" reads like a romance. The operation described at greatest length, supported by illustrative cases was a subperiosteal resection of the hip, which assured regeneration of the bone and restoration of function.

Sayre considered himself as proficient in mechanical as in operative surgery and devised many appliances, of which only the plaster jacket is still in use. This was a period of acrimonious controversy. The three conservatives regarded Sayre as an arrogant and mendacious exploiter of adventurous treatment and he put no restraint on his criticism of their deficiencies both individually and collectively. Knight was considered by his colleagues as a renegade because he "permitted no traction treatment" in his hospital. Davis had a comprehensive grievance and particularly against Taylor for the utilization of his inventions without due credit, "To rob a brother of his discoveries," should in his opinion be as "derogatory to a man's standing as to patent a brace," an ethical misstep which he had made apparently unwittingly. Taylor retorted "that the only impression that Davis' spinal brace made upon him was admiration for the ingenuity, which could devise a means which by no possibility could exert any mechanical purpose at all."

It is evident that the value of the work of the pioneers can be judged fairly only on the standard of their own day and as contrasted with the prevailing neglect of the deforming diseases.

From a technical standpoint the chief interest in Knight's "Orthopaedia" are the illustrations of the crude appliances which in his hands were so effective.

Davis's extravagant claims for elastic traction were rejected in his own lifetime. He insisted that traction should be applied in the line of deformity and at least this may be placed to his credit.

Taylor designed and applied his braces with a definite purpose and by raising the standard of mechanical treatment made a lasting impression on future practice.

Sayre's "peculiar views on pathology and treatment" have not stood the test of time. His most important function was to serve as the "forerunner of American Orthopaedic Surgery." Forerunner is the proper term, for according to the "American Textbook of Surgery," published in 1892, "Orthopaedic Surgery has properly to do with deformities and contractions, especially by some form or other of mechanical appliances."

This definition might well have been accepted by a large contingent of the Charter Members of the American Orthopaedic Association, for only 8 per cent of the papers published in the annual reports for the first ten years of its existence were on operative treatment; in numbers, actually less than are contained in a single issue of the Journal of Bone and Joint Surgery.

The most militant member of the conservative group was Newton M. Shaffer, a pupil of Knight and the successor of Taylor at the Orthopaedic Hospital, an organizer and second president of the Association. He presented at the Tenth International Congress at Vienna in 1890, his own definition of the scope of orthopedic surgery, which he evidently regarded as a compromise between the two factions. It was, in substance, that its field should be restricted to the class of cases for which specially constructed appliances were required in treatment. In such cases, surgery might be employed in a subsidiary capacity. This was evidently an involuntary and impersonal concession, for it was well known that he permitted no surgical intervention in the hospital that he controlled.

Shaffer was the last aggressive upholder of the old order, and by the end of the century the new era in the healing art, when mechanical and operative surgery should supplement one another in treatment, was at hand. It is since this time that the great advances in scope and effectiveness of orthopedic treatment have

been made, advances that must be credited in most instances directly or indirectly to surgery. Of this development, this hospital may serve as an example, for it represents a natural growth, free from academic restrictions from without, and from over-regimentation from within. Of this development I can speak from personal experience for I joined the staff in 1889, shortly after Gibney, who had served an apprenticeship of thirteen years under Knight, had succeeded him. He had then already begun the transformation of what was essentially a home for crippled children without trained nurses or expert mechanics, to what became eventually a hospital, without restriction as to age or sex, representing the most liberal interpretation of the scope of orthopedic surgery.

In the report for that year no operations were recorded as evidently they were few in number and of a minor character. In 1930, the concluding year of my active service, there were 1875 operations, and in the hernia department 1647, thus a total of 3522 operations on 3429 patients. Yet the operative cases in the orthopedic department represented barely 10 per cent of the patients under treatment. For in this hospital, the in and outdoor departments are combined in a continuous and interdependent service. Thus one may supervise his operative handiwork from beginning to end. It may be stated furthermore, that the opportunity offered for the direct inspection of the effects of disease and deformity has been a great service in the treatment of the non-operative cases.

The character of the service has greatly changed in recent years. In Knight's time "synovitic diseases of the joints" was by far the most important constituent of the practice. As late as 1910, 600 new cases of tuberculous disease, chiefly of the spine and hip, were recorded at the hospital and 35.3 per cent of the cases treated in the wards were of this character. Twenty years later, in 1930, the number had been reduced to 80 and the proportion in the wards to 2.7 per cent.

Even in this class of cases, surgical intervention, once considered only as a life-saving expedient, has proved of value as a conservative measure, as for example, the anchylosing operations on the spine to check the destructive process and progressive deformity.

In this connection it may be of interest to note that the Orthopaedic Hospital, for many years the upholder of the traction treatment of hip disease, has now become the foremost exponent of operative anchylosis as the most effective means of assuring a useful limb. Although as has been noted "hip disease" has become relatively an insignificant factor in the hospital routine, the therapeutic importance of the hip joint has been greatly increased.

The pioneers knew nothing of coxa vara, Legg-Perthes' disease, fracture of the hip in childhood or the epiphysial displacements of adolescence. These disabilities were probably classed as "Synovitic disease" and such errors in diagnosis doubtless explain the curative effects of the traction treatment.

Nor was there at this time effective treatment for the affections for which operative intervention was required, for example, for fixed distortion of the limbs, a common result of disease or injury of the joint; for congenital dislocation of the hip in its various stages; for fracture of the neck of the femur, either immediate or for non-union; nor for arthritis deformans.

Thus far only the hospital service has been considered to support the proposition that operative surgery has been the chief agent "in inaugurating Mott's New Era." Actually, the outdoor department is of far greater importance numerically and from the standpoint of the student, for in this heterogenous collection of cases drawn from all departments of medicine may be found every type of disability illustrating what may be called the natural history of the crippling diseases.

Here one has the opportunity to identify groups of cases, unrecognized and neglected and to establish the principles of treatment

that become generally available. As an illustration, I may cite what in one of my earliest contributions to orthopedic literature I termed the weak foot to distinguish it from the obvious deformity of flat foot. The weak foot was defined as a defective posture which induced disability and progressive deformity, that might be prevented and remedied by restoring the normal relations of the foot and leg. In my first year of service I succeeded in tabulating 100 of these cases. In 1930 over 5000 new cases of this type were recorded. In the meantime, under the name of broken arch it had become the most familiar of all the minor disabilities. The construction of shoes and supports designed to protect and to sustain the arch had become an important industry and it formed the cornerstone of the flourishing school of podiatry.

Mott has been credited with the definition of orthopedic surgery as the combination of surgery and mechanics. It must be borne in mind, however, that the surgery to which he referred was the subcutaneous division of contracted tissues. This was considered a great discovery because it was fairly free from the danger of infection. Thus the new era in a larger sense was postponed for half a century or until freedom from operative infection had been practically assured.

When orthopedic surgery outgrew the restrictions that had identified it with the mechanical treatment of deformity, it lost its former qualification as a specialty and became as Sayre had maintained, a branch of surgery.

It is particularly concerned with defects and disability of the bodily mechanism, to which every department of medicine contributes. Its field is the broad and ill defined region between general surgery and general medicine. It is most closely connected with the former in a cooperative sense, by fractures and acute diseases of the bones and joints, and with the latter, by paralytic disabilities and the so-called rheumatoid diseases of the joints. This therapeutic field provides an opportunity for many practitioners qualified or otherwise. Although the orthopedic surgeon because of his familiarity with the natural history of the disabling diseases should be best qualified to direct the treatment, he rarely sees the patient until the stage of deformity.

One may conclude, therefore, that although the potential scope of orthopedic surgery is large, the most stable contingent in practice will be the class of cases for which operative and mechanical surgery are essential, for neither the technical skill nor the experience that should direct these positive methods are at general command.

PRACTICAL CLINICAL GYNECOLOGY

HENRY C. FALK, M.D., F.A.C.S.

THIRD INSTALLMENT

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Chapter V

FIBROIDS

In discussing the question of fibroids it must first be understood that the terms "fibroids," "fibromyomata," "myomata" and "fibromata" are all synonymous. An absolutely pure fibroma or myoma is rare, as a rule, one or the other tissue will predominate.

Etiology of Fibroids

Heredity plays a very minor role in the etiology of fibroids. It seems to play a much smaller role in fibroids than it does in carcinoma. It is not unusual however, to find fibroids occurring in two or more sisters.

The theory that these tumors take origin from embryonal rests (Cohnheim-Ribbert) is frequently brought forth. Another theory advanced several years ago is based upon the idea that the uterine muscle undergoes cyclic changes similar to the endometrium. The sponsors of this theory stated that when there was an upset in the cyclic changes, such as would be produced by an over-production of the ovarian hormones, this upset would cause some change in the involution of the muscle fibers with a resulting fibroid formation.

There is apparently some relationship between sterility and the formation of fibroids. Just what this correlation is, is unknown. Fibroids seem to occur more often in sterile patients or those who have been sterile for a long time, than in patients who have borne several children.

Origin

Little is known about the actual origin of fibroids. They apparently develop from modified muscle tissue. If several very small fibroids are examined, some one spot in the circumference of the small tumor will be found where the fibroid and the muscle capsule around it are intimately blended, as if the muscle had something to do with the origin of the fibroid itself.

All fibroids start as **interstitial** or intramural tumor masses in the musculature of the uterus and grow in one of two directions, either toward the peritoneum, to become subperitoneal

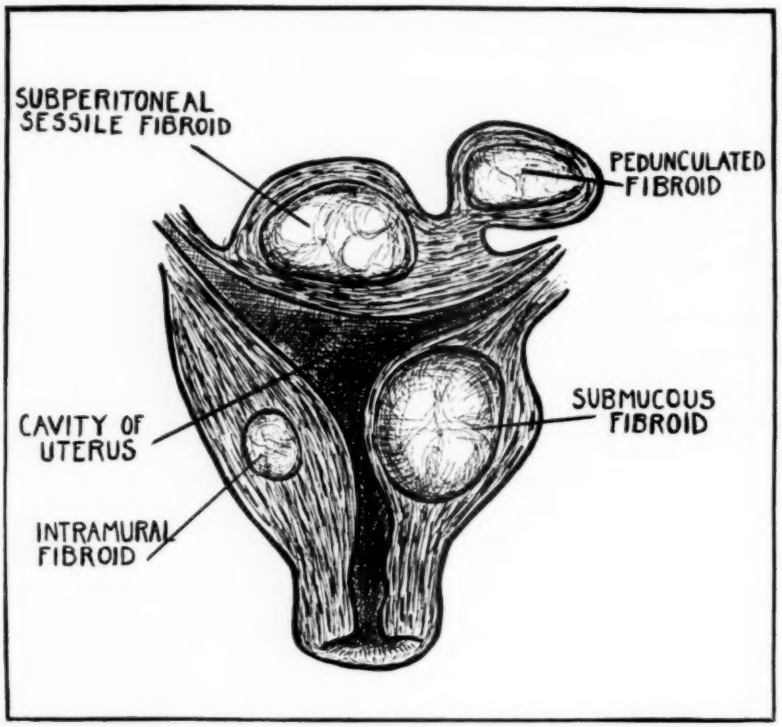

FIG. 59. Fibroids of the uterus, showing the various anatomical types.

or toward the uterine cavity to become submucous. They may be either sessile, with a very broad base or pedunculated with a rather narrow base (Fig. 59). If the tumor grows laterally between the layers of the broad ligament, it forms an intraligamentary fibroid. If the tumor takes origin from the cervical musculature, a cervical fibroid is formed.

GROSS PATHOLOGY

Single tumors may occur but as a rule they are multiple. They may be very small or very large. The largest fibroid reported in the literature weighed approximately ninety pounds.

Fibroids are always well circumscribed and do not infiltrate the tissue. They are firm to the touch, and, on section, the

muscle tissue retracts; this causes the fibroid, which is very dense and hard to project beyond the musculature. The cut section of the tumor is white, hard and firm to the touch and the strands or bands can be seen running in all directions. These strands are white and very glistening in character.

Frequently the question arises in a pedunculated submucous tumor mass, as to whether it is a polyp or a fibroid. As all submucous fibroids start intramurally and grow towards the endometrium, a layer of muscle tissue will always be found over the surface of the fibroid and immediately under the endometrium. This layer of muscle tissue may be very scant but it is there nevertheless, even though it may require a microscopic section to demonstrate its presence.

The blood vessels ramify the surface of the fibroids. There are very few blood vessels in the center of the tumor mass proper. The arteries are usually very small; the veins are quite large and are apparently out of all proportion to the arteries both as to the size and number.

Histology

This is quite uniform. It consists of bundles of nonstriped muscle and fibrous tissue, running in bands or whorls. When the fibres are cut lengthwise, they show long spindle-shaped cells, in bundles and in whorl-like arrangement. If the fibres are cut transversely to the long axis, the cells present themselves as small spheroidal masses of protoplasm with round central nuclei. Mitotic figures are very rarely seen in fibroids. That is important particularly in differentiating a cellular fibroma from one which has undergone sarcomatous change.

Owing to the lack of blood supply in the center of fibroid tumors of any size, various types of degenerative changes take place, hyaline degeneration being the most frequent. On section the hyaline degeneration shows itself grossly as whitish-yellow areas, sharply demarcated from the surrounding tissues. When blood pigments are present due to injury, all varieties of colors from yellow to grayish blue, to red, to brown and to reddish blue may be seen.

Should there be any interference with the venous return from the fibroids, the tumors become edematous and quite soft. An edematous fibroid on section is very moist. Occasionally the hyaline tissue disappears and spaces containing fluid develop. The wall of these spaces is composed of ragged hyaline tissue. There is no epithelial or endothelial lining to these cavities. The fluid in these cavities is either straw-colored, turbid, greenish or brownish and if infected may contain pure pus. These spaces or cavities are not true cysts but are reservoirs for broken down tissue. True cysts or dilated lymph spaces are lined by epithelium or endothelium.

It is peculiar that the closer the fibroid is to the endometrium, the less frequent are the degenerative changes. Most degenerative changes occur in fibroids that are pedunculated or parasitic. Calcium deposits are not infrequent in tumors which have undergone hyaline degeneration.

Sarcomatous Changes

The incidence of sarcomatous changes found in fibroids depends in a large measure on the pathologist, some finding an histological incidence as high as 25 per cent, others never finding any. The clinical incidence is less than 2 per cent.

It is difficult to decide when a fibroid has passed from the stage of a cellular fibroma to that of sarcoma. The difference is very arbitrary. What pathologist "A" may call a sarcoma, pathologist "B" may honestly call a cellular fibroma. The clinical course of the patient is usually the best guide. To find the correct histological incidence of sarcoma in fibroids, it would be necessary to examine all parts of all fibroids removed and that is practically impossible.

To recognize sarcoma on gross examination is rather important. In sarcoma, the white, coarse, fibrous whorl-like arrangement which is seen with fibroids, has been replaced by a yellow or yellowish-white homogeneous tissue. This tissue is practically devoid of fibers on gross examination and looks very much like a piece of raw pork. It is rather soft to the touch in comparison with a fibroid. Sarcomas also differ from fibroids in

that there is a marked increase in the number of blood vessels in the tumor mass. The presence of these blood vessels with the associated numerous small hemorrhages causes the tumor to

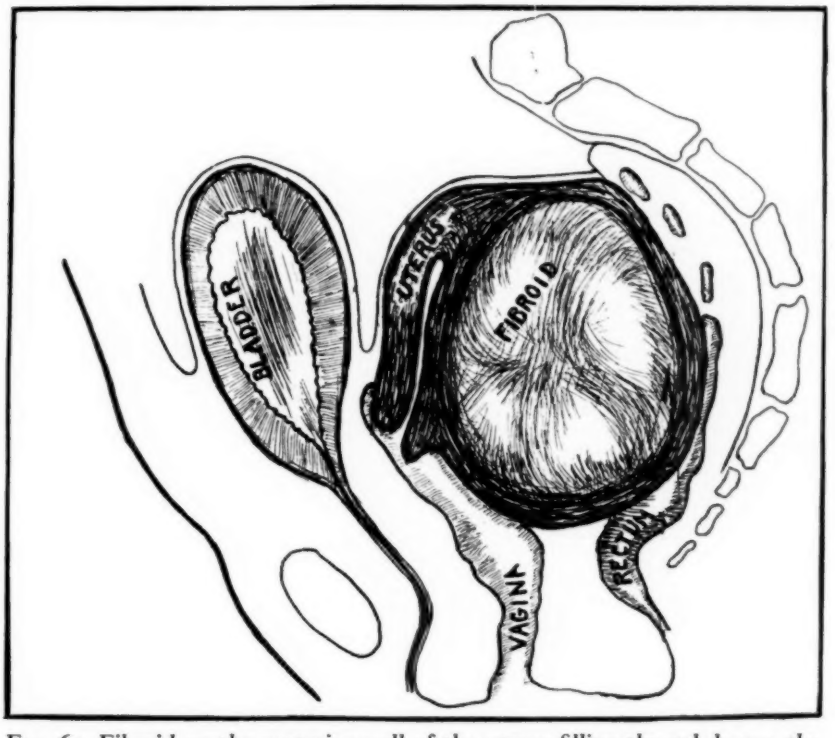

FIG. 60. Fibroid on the posterior wall of the uterus filling the cul-de-sac, the body of the uterus being forced anteriorly and upward.

have a mottled appearance, yellowish or brown in color due to the presence of blood pigment.

All tumors should be sectioned in the operating room at the time of the operation and examined grossly by the pathologist, to decide on gross examination whether or not a sarcoma is present. If a sarcoma is present a complete hysterectomy should be performed. In spite of this, the chances of cure are rather remote.

GROSS ANATOMY

The gross anatomy depends to a large extent upon the size, position and number of fibroids. Many small fibroids may be uniformly scattered throughout the uterus causing it to be but slightly enlarged and allowing it to occupy its normal position.

Posterior wall tumors may fill the cul-de-sac and force the body of the uterus well forward (Fig. 60). Fibroids on the anterior wall may force the uterus into the cul-de-sac. The

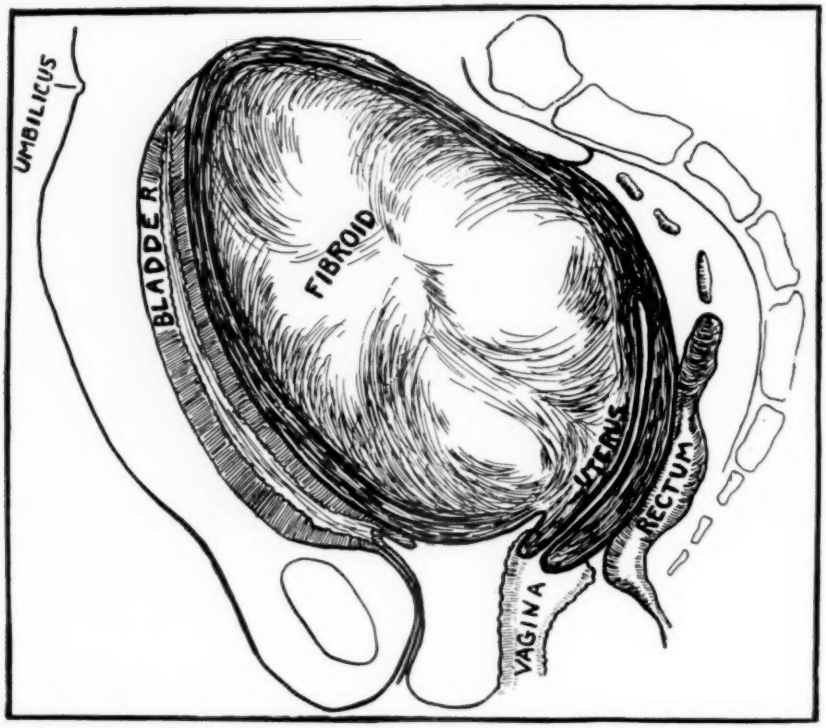

FIG. 61. Fibroid on the anterior wall of the uterus forcing the uterus into the cul-de-sac, the bladder lying on top and in front of the tumor mass.

bladder, in anterior wall tumors, may be on top or in front of the fibroid (Fig. 61) or be pushed below the tumor mass (Fig. 62). In cervical fibroids the entire lower segment may be involved and the fundus of the uterus may sit on top of the fibroid like a cap on top of the head.

The anatomical relationships of the bladder, ureters and uterine arteries are important, particularly from the surgical standpoint. The operative technique must be adapted to the modified anatomy and the gross pathology found at the time of the operation.

When a tumor mass involves the lateral wall of the uterus and extends out into the broad ligament, the uterine artery may be at any one of the four corners of the tumor mass and

should be sought in these places (Fig. 63). The ureters are always outside the capsule of the tumor and tend to remain close to the peritoneum. In enucleating intraligamentous

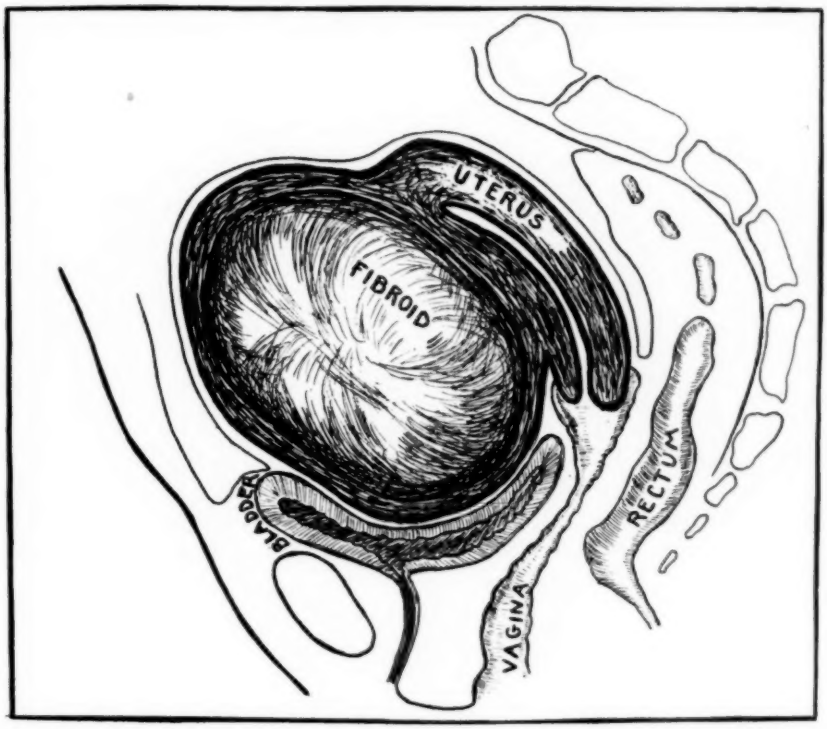

FIG. 62. Fibroid on anterior wall of the uterus with the tumor mass lying on top of the bladder.

fibroids the operator will avoid injury to the ureter if the tumor mass is removed from the inside of its capsule.

If the tumor mass projects laterally and it is closely combined with the uterus, one may find the tube and ovary on that side flattened out over the tumor; in which case the separation of the broad ligament with the insertion of the clamp through the avascular space, (step 3 in the operative procedure), may be done most easily from before backward (page 136). The round ligament passing over these large tumor masses may be markedly attenuated or hypertrophied.

The change in the relationship of the uterus and the various organs, vessels and other structures caused by the tumor growth, must constantly be kept in mind. If one will remember,

however, that fibroids begin in the musculature of the uterus and then grow outward, the various possible changes from the normal anatomy that might occur will be better understood.

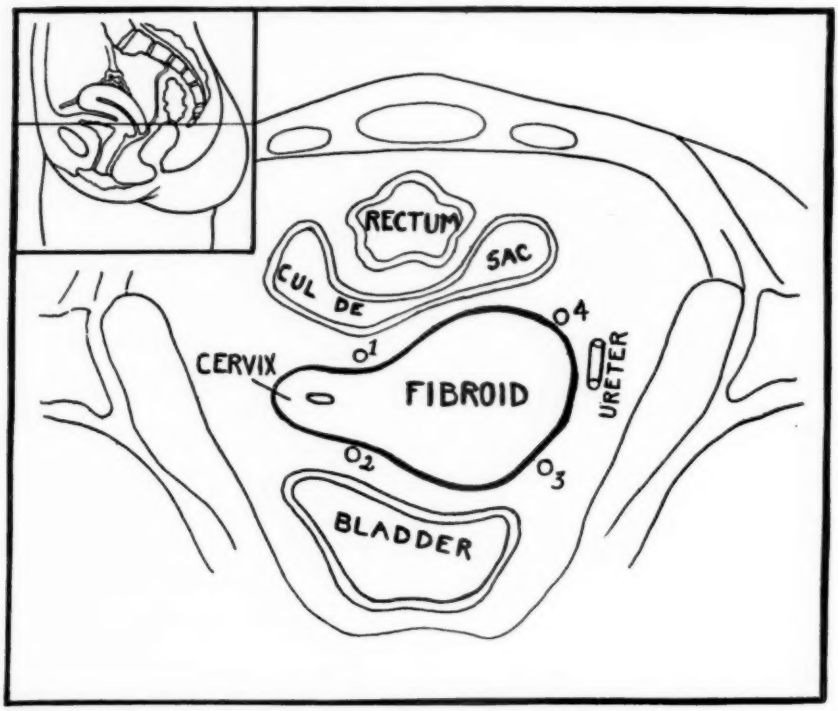

FIG. 63. Fibroid extending outward into broad ligament, showing 1-2-3-4, points to look for the possible location of the uterine artery. The ureter is always outside of the fibroid capsule. Insert shows level of transverse section.

One not infrequently finds marked dilatation of the superficial or deep lymphatics at the edge of the broad ligament, they look like elongated tortuous cysts. These might be quite confusing if not recognized as dilated lymph spaces.

PEDUNCULATED TUMORS

If it is accepted that fibroid tumors begin as intramural structures, how do these tumors become pedunculated? How do parasitic tumors develop?

All fibroids, as was stated, originate as interstitial tumors. The musculature of the uterus is constantly attempting to express these tumors. They may be pushed toward the peri-

toneal surface until finally they are pushed out of the uterine muscle and are attached to the uterus by a pedicle of peritoneum, varying amounts of musculature and blood vessels. This pedicle may become markedly attentuated, depending upon its length, and there may be one or more twists in it, thus interfering with the blood supply to the tumor and causing hyaline degeneration in the tumor mass.

The interference with the blood supply may cause necrosis to take place on the surface of the tumor; the omentum immediately becomes involved with the formation of an adhesion. The omentum can thus gradually take up the blood supply of the tumor mass itself until the pedicle entirely disappears (parasitic tumor). When the omentum takes up the blood supply of the tumor the vessels of the omentum become markedly dilated and there is a disappearance of the normal fat.

Point in Surgical Technique: As the omental vessels on parasitic fibroids are markedly dilated and as the fat in the omentum has disappeared, one should not apply clamps to the adhesions in separating them from the tumor mass, but should immediately ligate the proximal end of the vessels and put a clamp on the distal end, towards the tumor mass, cutting between. If a clamp is applied to both sides it very often tears away and much bleeding from these vessels may result.

If the musculature of the uterus forces the fibroid towards the cavity of the uterus the tumor first becomes submucous and then pedunculated. The further contractions of the uterus may then force the tumor mass through the cervix out of the uterine cavity and into the vagina.

When a pedunculated tumor from the uterine cavity is in the vagina and in constant contact with the vaginal epithelium, there may be a loss of the surface endometrium and its replacement by stratified, squamous epithelium. Tumor masses projecting into the vagina are constantly subjected to injury and infection; as a result, there is a marked round cell and polymorphonuclear leucocytic infiltration with the formation of a pyogenic membrane.

Submucous fibroids are very prone to become infected and slough. This may occur while the tumor is still submucous or it may not manifest itself until the tumor has become pedunculated and projects into the vagina. The sloughing usually begins at the most dependent part of the tumor. This sloughing mass in the cervix or vagina may cause a profuse discharge with a very offensive odor and may be mistaken for a carcinoma of the uterus or cervix.

Symptoms

A. Age Incidence. Fibroids may occur at any age during the active sex life of an individual. Most fibroids occur after the age of twenty years.

B. Change in Contour of the Abdomen. This depends upon (1) the size of the tumor, (2) its location, and (3) the adiposity of the individual.

If the tumor is lodged mainly in the pelvis, there will be no change in the abdominal contour even with fairly large tumor masses. If the tumor lifts itself out of the pelvis and the patient is obese, it may not be evident, but if the patient is thin, the change in contour of the abdomen may be quite noticeable.

C. Caput Medusa. Fibroid tumors rarely cause sufficient pressure on the abdominal vessels to interfere with the circulation. Therefore, one practically never sees a caput medusa (dilated abdominal veins) in these cases.

D. Menstrual Symptoms. No matter how large the fibroid, if there is no impingement upon the cavity of the uterus there is practically no alteration in the menstrual cycle. When the fibroid encroaches on the endometrium it puts the latter under tension. It is presumed that the large veins on the surface of the fibroid, with their congestion at the time of menstruation, cause the excessive bleeding. In other words, *a fibroid causes increased legal bleeding*, that is, more than normal bleeding at the regular time. When illegal bleeding, e.g., bleeding at irregular times, occurs, one must think of:

Uterine polyp,
Diffuse adenomyomata,
Fibrosis uteri,
Carcinoma of the fundus,
Submucous fibroid,
Ovarian dysfunction.

Submucous fibroids may cause severe and sometimes alarming hemorrhage. It is not unusual in this type of fibroids for the hemoglobin to drop as low as 15 or 20 per cent. One not infrequently sees patients with fibroids who have had profuse bleeding for a long time, lose so much blood that they give the impression of the severe anemia seen in malignancies.

E. Ascites. This is very rare and when it does occur, is found only with pedunculated subperitoneal fibroids. The ascites is probably due to a twisting of the pedicle with an interference of the blood supply of the tumor mass. When ascites is found and globular masses are palpated in the abdomen, the probabilities are that one is dealing with an ovarian tumor, rather than fibroids. Ovarian pathology is more often responsible for ascites than fibroids.

F. Pressure Symptoms. These are not infrequent. Hemorrhoids may occur as a result of pressure of the fibroid masses on the hemorrhoidal veins. Constipation is not infrequent, whether this results from pressure or other causes is difficult to say. Pressure symptoms occur mainly when the fibroid is on the anterior wall of the cervix, pressing on the bladder, thus giving a feeling of weight, dysuria and frequency. These symptoms disappear at night when the patient lies down, as the pressure on the bladder is removed. It is not unusual to see a patient with a small fibroid on the anterior wall, present all sorts of indefinite pressure symptoms and as the tumor becomes larger (if it does not become incarcerated) it lifts itself out of the pelvis completely and the patient's symptoms entirely disappear. This disappearance of the symptoms does not mean, and should not be used as, an index of subsiding pathology.

Dilatation of the ureters have been found fairly frequently in patients with moderately large fibroids. These dilatations seem to be due to the pressure on the ureter by the fibroids. When the fibroids are removed the ureters return to normal in a comparatively short time. How much permanent damage to kidney function can result because of the pressure is difficult to state at this time. A study of 100 of these cases is now being undertaken at the Harlem Hospital. It is hoped that this study will answer some of these questions.

G. Edema. Cases where edema of the extremities is found are rare. When edema of the legs does occur, it is probably not due to the fibroid itself, but due to kidney insufficiency or a poor myocardium.

H. Cardiac Changes. Much has been written on the subject of cardiac changes with fibroids: brown atrophy of the heart muscle. This has not been found to be the fact in our series. Most of the cardiac symptoms that these patients present seem to be due to poor nutrition of the cardiac muscle, caused by the anemia as a result of the excessive bleeding, rather than the effect of toxic substances from the fibroid acting on the heart muscle. If there were a true connection between the fibroid and any cardiac changes, the most marked cardiac changes should occur in individuals with very large fibroids and this is not the case. Many more cases of cardiac changes are seen in patients with small submucous fibroids with frequent hemorrhages over long periods of time than in the giant fibroids filling the entire abdomen.

I. Phlebitis, Thrombosis and Embolism. These seem to occur more frequently as a postoperative complication in fibroids than in other types of gynecological cases. Why this should be and whether it is due to some changes in the metabolism is not known. Some men believe that as a result of the pressure of the tumor masses there is a slowing of the blood stream in the local vessels with the formation of a bland thrombus. This thrombus, not being fixed to the interior of the vessel as an infectious thrombus is, would therefore be more apt to cause an embolus.

J. Bladder Symptoms. Cystitis caused by the fibroid itself is very rare. The most frequent bladder symptoms the patients present are those due to encroachment of the tumor on the bladder itself, feeling of weight, urgency and frequency of urination. Acute retention of urine is not unusual. This is usually due to an incarcerated tumor mass pressing against the lowermost portion of the bladder and the urethra and producing an inability on the part of the patient to void.

K. Vaginal Symptoms. Very few changes take place in the vagina as a result of fibroids. Occasionally it may become markedly elongated as a result of stretching over a fibroid mass or it may be drawn upward as a result of a fundal tumor. Low fibroids between the layers of the broad ligament may deform the vagina by indentation. When a fibroid is delivered through the cervix into the vagina the latter dilates to accommodate the tumor mass, no matter how large it is. One may find a vagina filled by a tumor mass as large as a child's head presenting itself at a small nulliparous or virginal outlet. In degenerating submucous fibroids or polyps there may be a foul, bloody vaginal discharge resembling that found in carcinoma of the cervix or body of the uterus.

L. Cervical Symptoms. Many changes can take place in the cervix as a result of fibroids. It can be pushed in any direction—forward, over the symphysis, backward into the hollow of the sacrum, laterally and upward so as to be completely out of reach, or downward so as to present itself at the outlet. The cervix may become so attenuated and stretched over a tumor mass as to be unrecognizable. Its extent may be so obscured that in attempting to do a supracervical hysterectomy the upper part of the vagina is cut across instead of the cervix.*

When a submucous fibroid is delivered through the cervix the latter can and will dilate itself sufficiently for its passage. These dilatations, however, disappear immediately after the

*This is one of the reasons for sterilizing the vagina preparatory to all gynecological laparotomies (p. 24). Occasionally in cervical fibroids the cervix may become flattened out over the tumor mass so as to be flush with the vault of the vagina.

tumor is removed. Occasionally during the course of the operation for the removal of these tumors, the cervix will "shut down" under vision.

Factors Influencing Operability

Suppuration of a fibroid is rare in the interstitial or subperitoneal type of tumor. It may be found as a complication of a postpartum or postabortal infection, as a result of direct or lymphatic extension. In the subperitoneal pedunculated type, the fibroid may become adherent to the bowel and take its blood supply from the intestines. In such cases an infection of the tumor may occur as a result of direct extension from the intestine.

Hyaline degeneration due to poor blood supply frequently precedes infection. This degeneration, particularly where the myoma has broken down and becomes soft, may grossly simulate suppuration. A smear, however, will demonstrate the absence of polymorphonuclear leucocytes.

When a myoma becomes infected from a pus tube, the infection usually starts and remains on the surface of the tumor. A myoma rarely becomes infected from its center outward.

Pus tubes or an infected myoma should be considered in a patient presenting an apparently uncomplicated fibroid yet associated with a high leucocyte count.

Ectopic pregnancy as a preoperative complication does occur. Kelly reported 6 in 1000 fibroids. In our series of 500 fibroids it was found twice, on both occasions the ectopic was not diagnosed but was an accidental finding.

Carcinoma as a preoperative complication can occur. If one will remember that fibroids form more than one-sixth of all gynecological pathological conditions seen and that carcinoma of the uterus is not rare, a coincidental occurrence of the two conditions should not be infrequent. There is no definite relationship, etiological or otherwise, between the two conditions.

The differential diagnosis between a foul, sloughing submucous myoma and carcinoma of the fundus is almost impossible without a curettage and a histological examination of the curettings.

The Differential Diagnosis of Fibroids

The most important single condition to differentiate from fibroids is pregnancy. *No patient in whom there is any question of pregnancy should be operated upon unless an A-Z test has been done.*

PREGNANCY	MYOMA
Amenorrhea	Metrorrhagia
Colostrum in breasts	Breasts negative, possible yellow secretion
A-Z positive	A-Z negative
Smooth mass	Irregular nodular mass
Soft mass	Hard mass
Cervix soft, blue.	Cervix hard, pink.

Occasionally there has been nothing in the history to suggest a pregnancy and on opening the abdomen one is confronted with the differential diagnosis between a pregnant uterus and a soft myoma. The uterus in pregnancy is bluish and in fibroids it is usually pink. The most important differential point in diagnosis is the relationship between the round ligaments, the tubes, the ovaries and the mass. In a pregnant uterus the relationship of the round ligament, tubes and uterus to the fundus remains the same, no matter how large that uterus becomes (Figs. 64 and 65). In a fibroid, however, these structures assume an eccentric relationship to the tumor mass. If the differentiation between the two conditions is still difficult or impossible one may resort to aspiration of the tumor mass. If a pregnancy is present amniotic fluid will be withdrawn and the differential diagnosis made with no injury to the pregnancy.

A peculiar and yet not infrequent error in diagnosis is caused by an old ectopic pregnancy. An unruptured tubal

pregnancy, a tubal abortion, with hemorrhage and marked omental adhesions, has been mistaken for a fibroid. When a patient gives a history of a period of amenorrhea or some

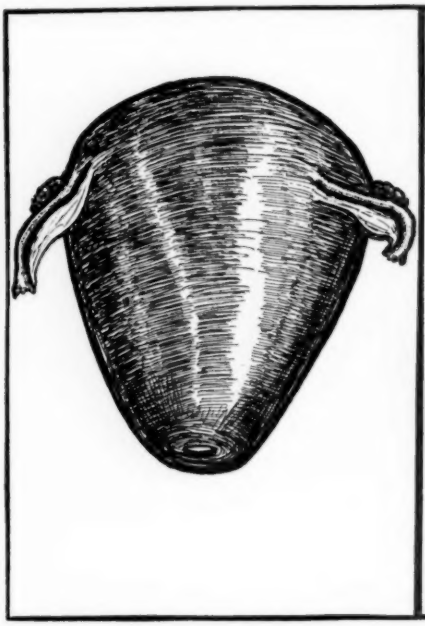

FIG. 64. Normal relationship of round ligaments and tubes seen in a pregnant uterus.

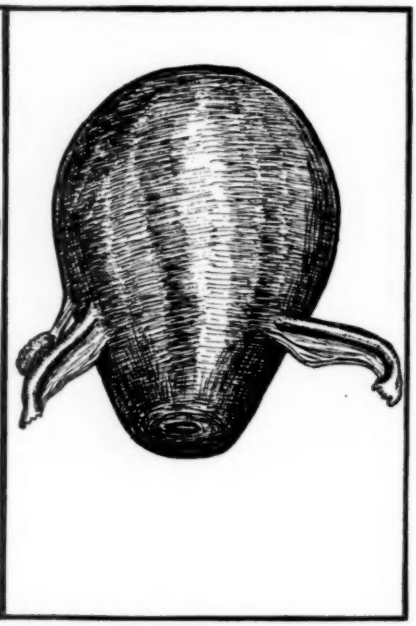

FIG. 65. Eccentric arrangement of tubes and round ligaments when a fibroid is present in the fundus.

irregularity in the menstrual cycle, always think of the possibility of an ectopic, even if a large tumor mass occupies the pelvis.

The differentiation between a fibroid and a solid tumor of the ovary is frequently very difficult as they both may have a pedicle, but as a rule the ovarian pedicle is longer. An ovarian tumor can almost always be displaced upward entirely away from the uterus, but a fibroid is usually attached more closely to the uterus and cannot be displaced. Ascites is more common with ovarian tumors. Ovarian cysts are not so difficult to differentiate from fibroids because they have a different feel, a cystic feel.

When a patient, who has had a previous gynecological operation, presents herself complaining of profuse or irregular

bleeding and an irregular mass is palpable in the pelvis, one should be careful about calling this mass a fibroid; because postoperative adhesions frequently gives one the impression of an enlarged uterus, whereas a cystic ovary or ovarian dysfunction may cause the excessive vaginal bleeding.

Surgical Management of Fibroids

The fact of primary importance with regard to the surgical management of fibroids that must be constantly remembered is, that, **every woman who has fibroids does not necessarily have to be operated upon.**

Fibroid tumors which (1) are producing symptoms, (2) are rapidly growing and (3) are causing mental distress to the patient, should be operated upon.

Submucous fibroids almost invariably cause excessive vaginal bleeding. They are very prone to infection. Due to their position in the uterus they are frequently expressed into the cavity of the uterus or vagina and become infected. They must practically always be operated upon.

Subserous fibroids cause very few or no symptoms. Infection in subserous fibroids are infrequent. They do not cause excessive bleeding. Therefore the presence of subserous fibroids is not necessarily an indication for operation.

When a patient presents herself with fibroids and the indications for surgery are present the question arises: what type of operation shall be performed? The operations of choice are: (1) myomectomy and (2) hysterectomy.

What are the advantages of myomectomy?

1. It preserves menstruation.

2. The possibility of pregnancy is still present in women who are within the childbearing age.

3. It prevents the symptoms of an artificial menopause.

4. The advantage to a young, unmarried woman from the psychic angle is untold. She continues to menstruate, she can get married as she has a uterus and therefore retains the possibility of becoming pregnant.

What are the disadvantages of myomectomy?

1. It may not relieve the symptoms for which the patient has come to operation. A large number of fibroids may be removed and yet a small pedunculated or submucous fibroid which could not be felt and therefore was not removed, may continue to cause the same symptoms for which the patient sought relief.

2. There is always a possibility of a recurrence of the fibroids.

3. The postoperative morbidity in cases of myomectomy is greater than the postoperative morbidity in hysterectomy.

4. Myomectomy is usually more difficult technically, than superacervical hysterectomy.

5. Owing to the technical difficulties and the marked increase in hemorrhage, myomectomy is much more hazardous in frail, anemic women. In women whose hemoglobin is as low as 20 to 25 per cent, even though they receive a preoperative and postoperative transfusion, the hemorrhage associated with the myomectomy may be enough to push such a patient over the danger line; whereas a hysterectomy, in the same patient, could be practically bloodless and therefore less hazardous.

In comparing a large series of cases where myomectomy or hysterectomy were performed, it was shown that only 75 per cent of the cases were cured by myomectomy, whereas 97 per cent were cured by hysterectomy.

Factors Influencing the Type of Operation Chosen

Myomectomy can be performed on subperitoneal, pedunculated, interstitial fibroids and occasionally in submucous fibroids. In the latter, there is always the danger of opening the cavity of the uterus. As a rule the cavity of the uterus is sterile. If however, a submucous or pedunculated fibroid is presenting itself at the internal os or in the cervix, it may have become infected, thereby infecting the cavity of the uterus. One must therefore always exercise special care not to enter the cavity of the uterus in the removal of the submucous fibroids. If there is

any possibility of entering the cavity of the uterus, proper preoperative preparation and sterilization of the cavity should be done. This will reduce the dangers of infection to a minimum. Preoperatively the uterine cavity should be sterilized with either iodine or mercurochrome from below, in the anesthesia room. If at any time during the operation the surgeon enters the uterine cavity, iodine on an applicator or iodine soaked packing should be inserted into the uterine cavity. The opening in the cavity should be immediately closed and the instruments, which were used should be discarded as dirty. If there is any question in the operator's mind as to the sterility of the field, it should be changed, including the gloves.

"*You are dirty, if there is any doubt in your mind as to whether you are clean.*"

If there are fibroids present in the uterus and a necrotic submucous fibroid is presenting itself in the cervix or vagina, a vaginal myomectomy must first be performed. The hysterectomy should not be done until the patient has had two normal menstrual periods. If an abdominal hysterectomy is done too soon after a vaginal myomectomy, the patient may develop a peritonitis from the infected endometrium, causing a fatality. Endometritis is a self-limited disease and, as a rule, disappears after one menstrual period. Chronic endometritis is rare. Nature tends to clear up any infection in the uterine cavity very rapidly if allowed the necessary time.

In myomas of the broad ligament, intraligamentous fibroids, subvesical fibroids and cervical fibroids a hysterectomy is the procedure of choice. The young operator may encounter considerable difficulty in attempting myomectomy in these cases. Only after he has had considerable experience in gynecological surgery should he attempt a myomectomy in cases of intraligamentous and cervical fibroids.

Dangers in operating on myomas of the broad ligament (intraligamentous and cervical fibroids): (1) injury to the ureter, (2) injury to the bladder and (3) oozing between the layers of the broad ligament with the development of a hematoma causing late morbidity with the possible development of

an intraligamentous abscess. All these complications must be carefully weighed before attempting to do a myomectomy on any one of these types of cases.

Never operate on a fibroid uterus unless the patient has given consent to do whatever surgical procedure may be found necessary or feasible. If the patient insists on a myomectomy, tell her that everything possible to save the uterus will be done, but if, during the operation, a hysterectomy is necessary to save the patient's life, consent must be granted.

Myomectomies cannot be done on cases of diffuse adenomyomas (of Cullen) of the uterus. Myomectomy is also totally unsuited for fibroids that are infected. The presence or absence of infection in fibroids can be judged by the leucocyte count and the sedimentation time. These are not absolute, as there may be other pelvic infection present. If a simple fibroid presents a leucocytosis or rapid sedimentation time, in all probabilities it is infected or complicated by pus tubes.

If a fibroid is complicated by a carcinoma of the cervix, that fibroid had best be treated with *x*-ray or radium. If they are not available radical surgery can be performed. If a fibroid is complicated by carcinoma of the body of the uterus, radical surgery should always be done.

Why this difference between carcinoma of the body of the uterus and carcinoma of the cervix?

Carcinomas of the cervix are practically all infected with streptococci. If treated with *x*-ray and radium the cervical lesion as a rule heals. After the infected cervix has healed, radical surgery can be carried out if necessary with a minimal risk of infection to the patient.

When carcinoma of the body of the uterus complicates a fibroid, as a rule, the diagnosis is not made preoperatively. The diagnosis can be made if a curettage were done before the radical surgical procedure was performed. When the diagnosis is made, vaginal hysterectomy or total abdominal hysterectomy can be done with little risk of infection to the patient.

When a hysterectomy is decided upon, the supracervical type of operation is the procedure of choice. The mortality of

total hysterectomy is greater than that of the supracervical operation. The argument that carcinoma may occur in the retained cervix does not seem to be of sufficient importance to warrant the total operation. The primary mortality of radical hysterectomy is definitely greater than the incidence of carcinoma in the retained cervical stumps. These are, not alone our statistics, but those of other clinics as well. The incidence of carcinoma of the cervix is definitely low. If the cervix is badly lacerated or eroded, it should be treated before the hysterectomy is undertaken. A large percentage of cervical lesions, excluding carcinoma, can be cleared up and made practically inoccuous with office treatment. When the cervical lesion has been cured a supracervical hysterectomy can be performed.

Radiation Therapy

Fibroid tumors of the uterus can be treated by *x*-ray and radium. There are however, certain facts which must be thoroughly understood before advocating this procedure.

1. Radiation therapy primarily attacks the ovaries and secondarily the tumor masses; so that when it is used in young women under forty years, it abolishes ovarian function and produces distressing menopausal symptoms.

2. After the establishment of the amenorrhea the tumors shrink in size and in about 40 per cent of the cases the tumors disappear. In most patients with fibroids the tumors shrink for about one year and then remain stationary.

3. If the patient's symptoms recur or if radiation therapy is not curative it does not preclude surgery.

Indications. A fibroid which

1. Causes excessive bleeding,
2. Is intramural,
3. Is not degenerating,
4. Is not causing pressure symptoms, and
5. Is not complicated by other pelvic pathology, especially infections:

in a woman over forty years of age *may be treated with x-ray and radium.*

Radiation therapy in a woman under forty years is indicated only when she is a poor surgical risk due to some co-existing disease, e.g., cardiac, renal, etc.

Contraindications. A fibroid which

1. Is larger than a three months pregnant uterus,
2. Is submucous, pedunculated or polypoid,
3. Is undergoing some form of degeneration or becoming calcified,
4. Cannot be accurately diagnosed, especially the differential between fibroid and ovarian tumors,
5. Is causing pressure symptoms either by its presence or location,
6. Is rapidly growing and soft and may have sarcomatous change, and
7. Has been previously operated upon and may therefore have intestinal adhesions (radiation therapy might cause severe intestinal complications):

should not be treated with x-ray or radium.

Preparation of the Patient for Operation

All fibroid cases should have the following laboratory data preoperatively:

1. Complete blood count.
2. Complete urine.
3. Wassermann or Kahn test.
4. Sedimentation time.
5. Phenolsulphonephthalein test of kidney function.
6. Mosenthal test for kidney function.
7. Blood chemistry, if indicated. If laboratory facilites allow, blood chemistry should be done routinely.
8. Two or three blood pressure readings.

Preparation of the Patient

All patients coming to the operating room should be prepared for a dilatation and curettage and laparotomy, all pubic and abdominal hair should be removed. In the anesthesia room after anesthesia has been induced, the patient should be placed in the lithotomy position, painted or sprayed with mercurochrome (Scott's solution) and catheterized. At catheterization, urine must always be obtained, thereby insuring the fact that the catheter has been in the bladder. There is no single factor which tends to make a hysterectomy more difficult than a full bladder. Following catheterization the patient should be

examined under narcosis and an exact pathological diagnosis made. Following the examination, the vagina is thoroughly painted or sprayed with mercurochrome, the cervix is painted and if there is any possibility of entering the uterine cavity, a cannula is introduced into the cervical canal and without pressure mercurochrome or iodine solution is injected into the uterine cavity. The patient is then placed in the dorsal position and brought into the operation room.

Technique of Myomectomy

Step 1. The abdomen is opened with the usual paramedian incision (page 90).

Step 2. The pelvis is thoroughly walled off, using the three pad technique (Fig. 47).

Step 3. Isolate the factors. Always carefully and completely isolate all the factors before any actual cutting or operating is begun. *If the preliminary isolation of all the factors is carried out, most surgical procedures become comparatively simple.*

Step 4. After all factors are isolated, the uterus must be carefully palpated so as to identify the number and location of the various tumors. If the number and location of all the tumors is not known some of the sutured area may be reopened by mistake as sutured uterine muscle following myomectomy feels like tumor masses.

Step 5. Remove all pedunculated fibroids first with a simple circular or elliptical incision around the base of the pedicle and a figure of "8" stitch (Fig. 66).

To remove a sessile, interstitial or intramural fibroid, an incision is made as far forward on the anterior uterine wall as possible, so as to reduce the possibility of intestinal adhesions to a minimum. It is made over the most prominent part of the tumor, going through the muscle, down to the capsule of the tumor. *Make the incision ample. Always remember that the patient has two tubes and that there is a cavity of the uterus.* When the fibroid is reached it can usually be recognized by the difference in color as compared to the uterine muscle. When the capsule of the tumor is exposed, two or three large

vessels are usually cut and bleed freely. Do not grasp these bleeders with small artery clamps, they won't hold but use small Kocher clamps.

FIG. 66. Pedunculated fibroids removed with an elliptical incision and a figure of "8" stitch.

Once the tumor is exposed it can be placed under tension by the hand, under the tumor, pressing it into the uterine wound, or it can be grasped with a tenaculum and drawn into the wound. With a curved scissors, sticking close to the capsule of the tumor and following definite lines of cleavage, using sharp and blunt dissection, the tumor is removed. While the tumor is still attached to the lowest part of the cavity, which is well exposed, the inside of the cavity is grasped with Allis clamps so as to completely evert it. This greatly aids the closure of the cavity and the prevention of dead spaces. The cavity is closed with interrupted plain catgut sutures placed in tiers using a figure of "8" stitch. All dead spaces must be eliminated and all bleeding must be controlled. The superficial portion of the cavity and the peritoneal edge are closed with a stitch very similar to the stitch used in the Bell-Beuttner operation (Fig. 67).

All sutures are of No. 2 plain catgut on a medium size Mayo needle. A mattress suture may be used instead of the figure of "8." All the ragged edges should be cut away.

Surgical Axiom: **Do not approach a second fibroid until the first one has been taken care of and the bleeding stopped.**

Following the removal of all the fibroids, some form of

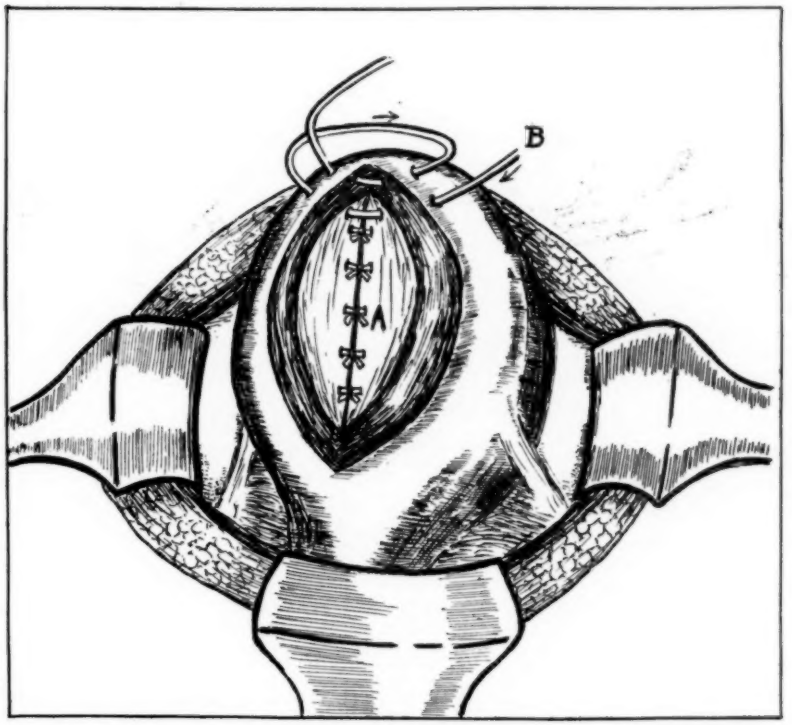

FIG. 67. Myomectomy, fibroid removed from anterior wall of uterus. A, interrupted stitches, deep, to obliterate dead spaces; B, modified Stewart stitch to close superficial layer.

suspension, suturing the posterior wall of the uterus to the abdominal wall, should be carried out.

TECHNICAL PROCEDURE IN HYSTERECTOMY

Surgical Axiom: **Do not attempt to operate through too small an incision. One inch below is worth two inches above.**

An ample paramedian incision is made. Cut the fascia of the rectus sheath down to the pubic bone. Insert the three abdominal pads thus isolating the operative field. In hysterectomy it is often advisable to insert a fourth laparotomy pad to completely isolate the field and also to cover the sigmoid and the cul-de-sac, so that if there is any spill, it will be on the pad and not on the peritoneum.

Identify all the factors: the round ligaments, uterus, tubes and ovaries.

In doing a hysterectomy with the clamp suture technique,

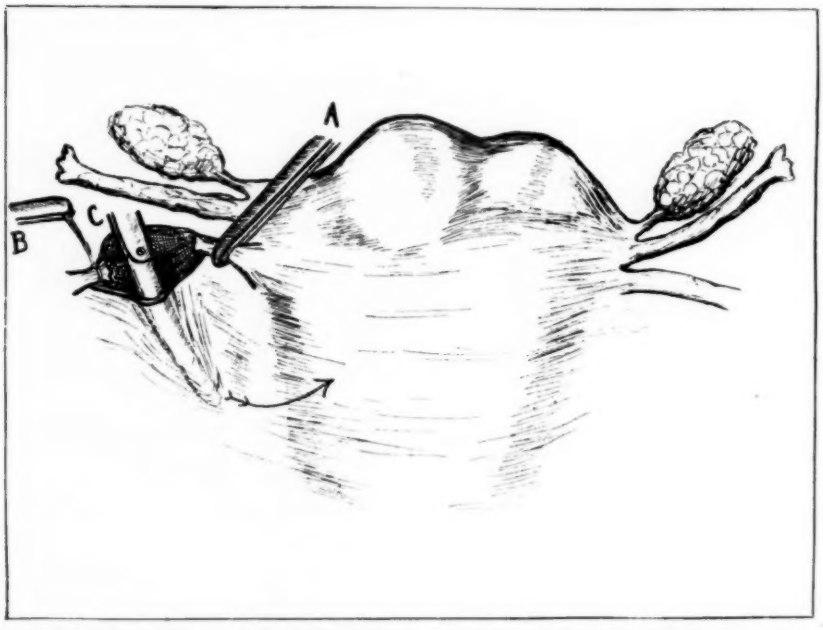

FIG. 68. Hysterectomy technique. Steps 1 and 2. A, clamp applied to uterine end of round ligament; B, Kut-Klamp applied to ligature on outer end of round ligament; C, scissors inserted under vesicouterine fold to separate it from the uterus before cutting it close to the uterus.

ten sutures are used. Sutures 1 to 6 and sutures 8 and 9 are of No. 2 plain catgut, cut in three, on a medium size Mayo needle. Suture 7 is of No. 2 plain catgut, cut in two, on a cutting needle. Suture 10 is of No. 2 plain catgut, cut in two, on a moderately small Mayo needle.

Step 1. Clamp, ligate and cut the round ligament of the uterus on the right side.

A clamp is applied to the right round ligament near the uterus (Fig. 68, A). The round ligament is lifted with a mouse-tooth forceps and suture 1 is placed in the loose avascular tissue under the round ligament and tied. The round ligament is cut and the suture is left about 4 inches long and a Kut-Klamp (Fig. 69) applied to its end. One of the most frequent

errors in technique is to place this suture too close to the uterine end of the round ligament. As a result it is difficult to find the plane of cleavage of the vesicouterine fold, which is

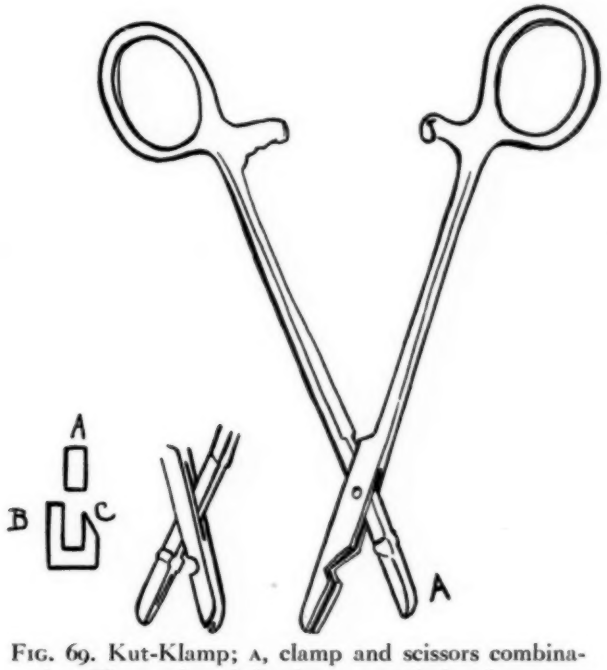

FIG. 69. Kut-Klamp; A, clamp and scissors combination. The portion of the clamp A on closing down on B acts as a clamp and holds the catgut while edge C acts as a scissors and cuts off the excess portion of the gut (*devised by Solomon*).

the next step in the procedure. This suture should be placed at a distance of 2 to 4 cm. from the uterine cornu.

Step 2. Opening the vesicouterine fold on the right side.

The uterus is drawn to the left, the first assistant grasps the suture on the cut edge of the round ligament, holding it taut and to the right, and the operator grasps the edge of the vesicouterine fold of the peritoneum with a mouse-tooth forceps at the point where it has been cut close to the round ligament and inserts a curved Mayo scissors into this space (Fig. 68, C). The point of the scissors is toward the peritoneum. The scissors are directed downward, away from and not toward the uterus. The scissors are opened (blunt dissection) and closed, the closed scissors is then brought towards the uterus and

the vesicouterine fold is cut close to the uterus, from right to left, to the midline. *Leave as much peritoneum on the vesicouterine fold as possible.* The vesicouterine fold is grasped

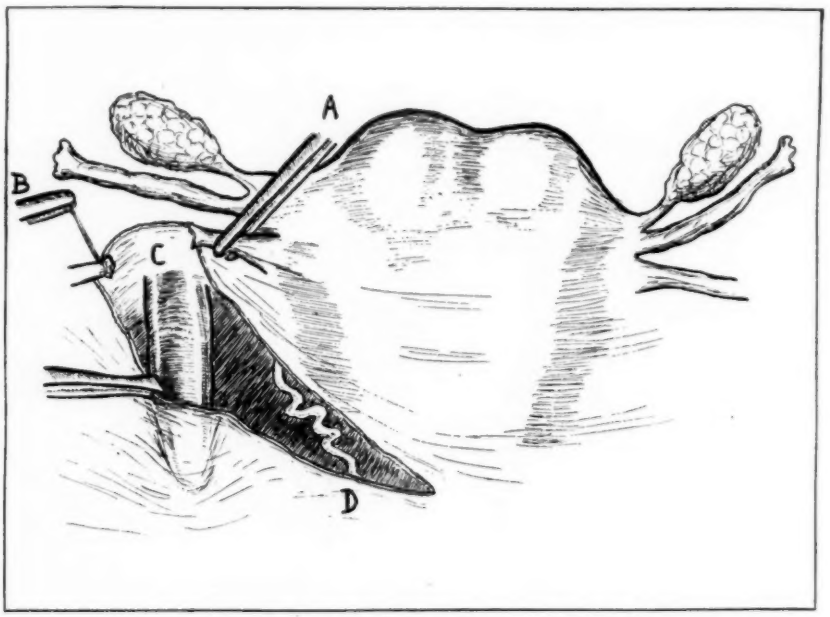

FIG. 70. A, clamp on uterine end of round ligament; B, Kut-Klamp on ligature on outer end of round ligament; C, finger introduced into vesicouterine fold to separate it by blunt dissection; D, uterine artery.

with a mouse-tooth forceps and the index finger is introduced into the space, separating the vesicouterine fold from the underlying structures from above downward (blunt dissection) and exposing the avascular space (Fig. 70).

Step 3. Opening of avascular space and ligation of broad or infundibulopelvic ligament.

The operator introduces a curved Kelly clamp, from behind forward, under the round ligament of the ovary, through the avascular space (Fig. 71, insert). The clamp is opened so as to make a large enough opening in the broad ligament for the assistant to introduce a curved Kelly clamp, from before backward, close to the uterus, one blade going through the avascular space and the other over the top of the broad ligament (Fig. 71, A, B). This clamp is closed. On inserting this clamp it may be necessary to remove the clamp on the

round ligament of the uterus (Step 1). A second clamp is introduced in the same manner from before backward by the assistant, leaving enough space between the clamps, so that the

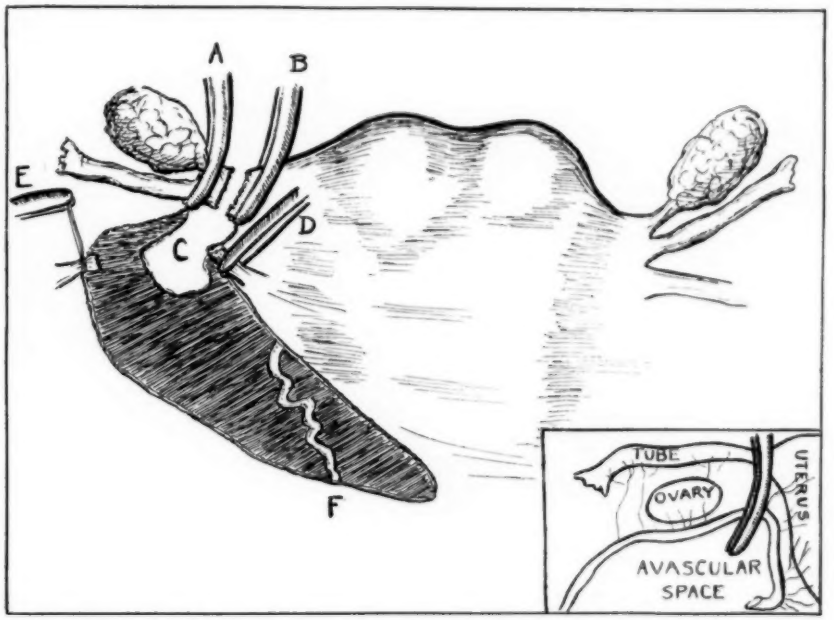

FIG. 71. Step 3. Insert shows clamp introduced from behind, under round ligament of the ovary, through the avascular space; A, B clamps on tube and round ligament of the ovary, through avascular space; broad ligament cut down into avascular space C; D, E, clamps on round ligament; F, uterine artery.

broad ligament can be cut. The broad ligament is cut between the clamps (Fig. 71, C).

Suture 2 is now inserted. It is introduced below the clamp on the cut edge of the broad ligament. The operator grasps the clamp on the broad ligament and introduces the suture from behind forward under the edge of the avascular space (Fig. 52). The needle is then brought from before backward, catching the very edge of the tube at a point ¼ inch behind the clamp. Occasionally it is necessary to catch the edge of the round ligament of the ovary in this suture. This ligature is tied by the operator and the assistant removes the clamp slowly. This suture is left long (4 inches) and a Kut-Klamp is applied (Fig. 72).

Step 4. Clamp, ligate and cut left round ligament.

The tumor mass is now drawn to the patient's right. The left round ligament is clamped, cut and ligated, in the same manner as on the right side, using suture 3.

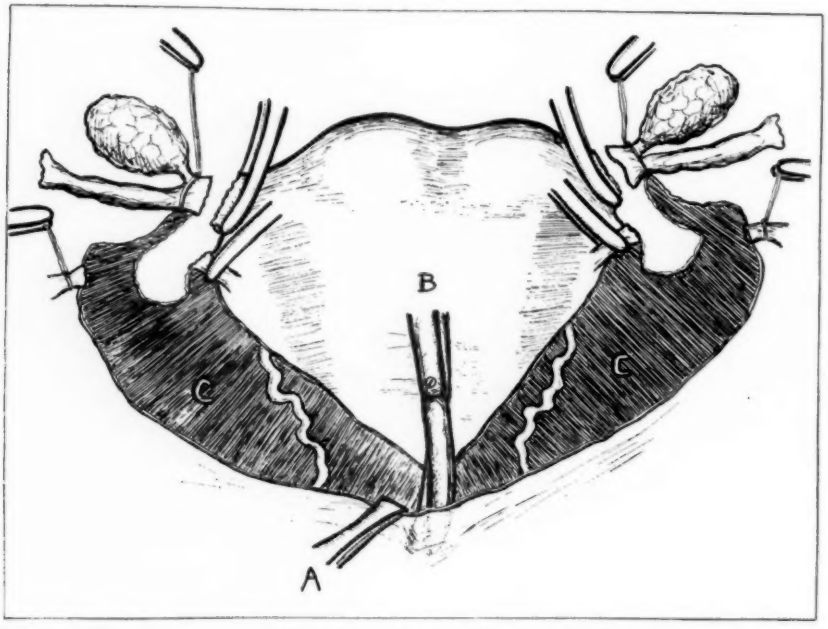

FIG. 72. Steps 4, 5 and 6. Round and broad ligaments clamped and sutured on both sides; forceps A, lifts vesicouterine fold so that scissors B, can cut dense adhesion at the midpoint; C, open vesicouterine space.

Step 5. Opening the vesicouterine fold on the left side.

The vesicouterine fold on the left side is treated in the same manner as the right except at the midpoint. At the midpoint of the vesicouterine fold of peritoneum, there is a fairly dense adhesion which does not separate very readily and must be cut in order to be separated (Fig. 72). The peritoneum is lifted at this point and the adhesion cut. The vesicouterine fold of peritoneum is then pushed downward by blunt dissection with the finger, thoroughly separating the bladder from the anterior wall of the uterus and upper part of the vagina.

Step 6. Opening of the avascular space on the left side, clamp, cut and ligate broad or infundibulopelvic ligament.

The avascular space on the left side is found, the clamp introduced from behind forward, the same as on the right side.

Two clamps are applied to the broad ligament by the assistant, the same as on the right. The operator cuts between the clamps.

Suture ligature 4 is introduced in the same way as on the right side, that is, from behind forward. The ends, however, are now towards the assistant, not towards the operator and the assistant ties this suture, the operator removing the clamp from the broad ligament. It is preferable to have the assistant tie this ligature as it is easier for him to do so. The operator may occasionally be unable to see what he is tying because the edge of the broad ligament may be under the edge of the abdominal wall on the left side.

Step 7. Suture of the left uterine artery (suture 5).

The uterus is thrown forward and the hand is introduced into the cul-de-sac and the lowermost point of the cervix is palpated. One may then judge the approximate location of the internal os on the posterior wall of the uterus. A heavy clamp is then placed on the uterine artery at right angles to the uterus and 1 cm. above the judged level of the internal os. The clamp is pushed into the edge of the uterus and as it closes, the ends of the clamp will slip off most of the uterine muscle and will grasp all the vessels (Fig. 73A).

Suture 5 is now introduced. The needle goes from before backward at the level of the internal os and at right angles to the uterus and is inserted about 1 cm. below the clamp. Some of the cervical tissue may be included with this needle but not too much. This suture is then tied by the operator. As the first knot is tightened, the assistant cuts the left uterine artery close to the clamp with a knife, and allows the knife to enter the uterine muscle (Fig. 73). If the suture is tied with two knots before the vessels are cut, the suture will not control the bleeding because it will not compress the tissues sufficiently. As the cutting is done by the assistant, the operator continues to tighten the knot; the second and third knots are applied and the ligature is cut fairly long.

Step 8. Suture of the right uterine artery (suture 6).

The same procedure is carried out on the right uterine artery except that on this side the suture is introduced from

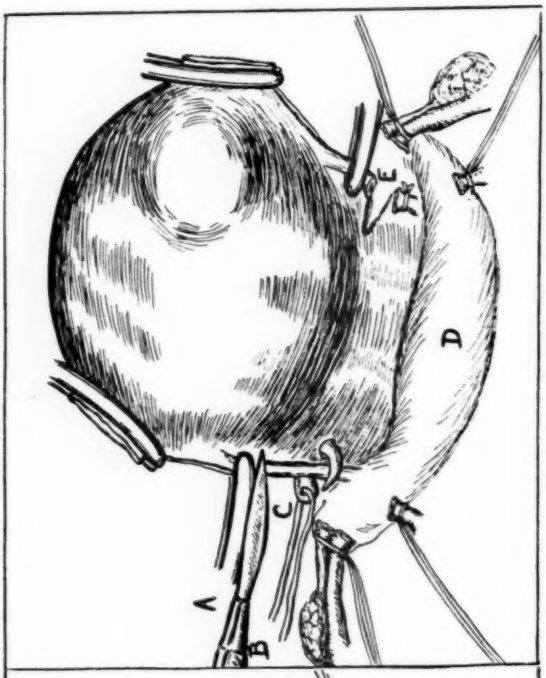

FIG. 74. Step 8. Suture of the right uterine artery; A, clamp on uterine artery; B, knife; C, suture ligature introduced from behind forward; D, vesicouterine space; E, cut left uterine artery.

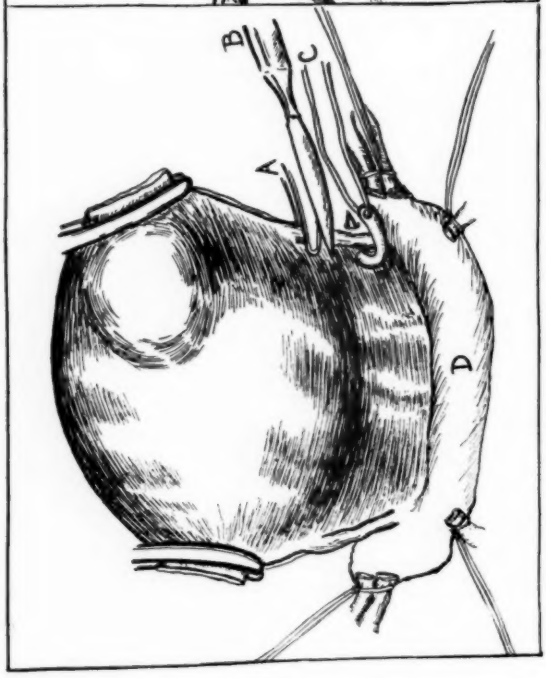

FIG. 73. Step 7. Suture of the left uterine artery, uterus drawn to right; A, clamp applied to the uterine artery; B, knife; C, needle going from before backwards passing suture ligature around uterine artery; the artery is cut while the first knot is being tightened; D, vesicouterine space.

behind forward: in this way, the operator can introduce the needle at right angles to the uterus and parallel to the clamp that has already been applied (Fig. 74). The right uterine

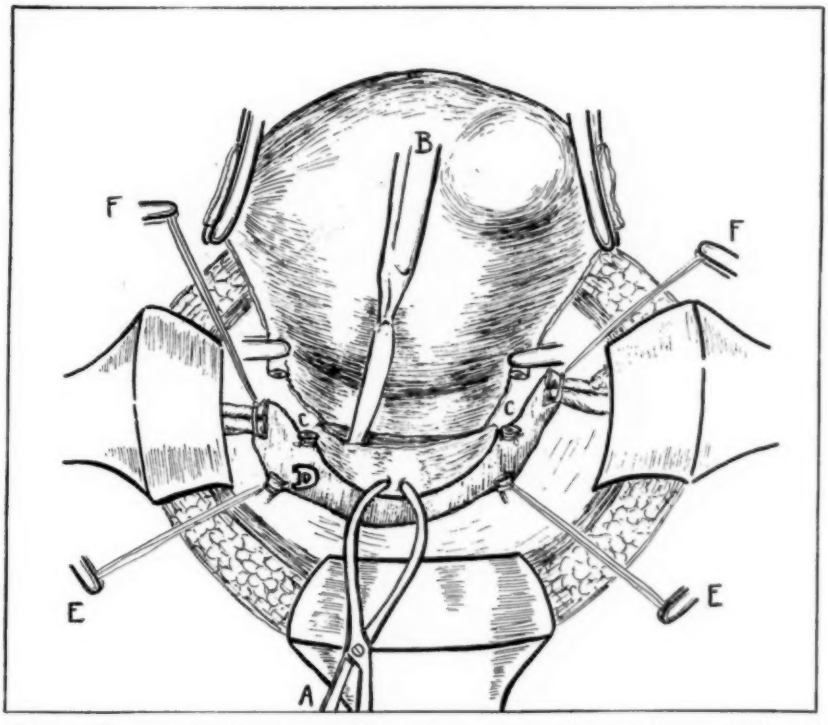

FIG. 75. Step 9. Cutting across the cervix; A, tenaculum on lower portion of cervix; B, knife cutting the cervix; C, uterine arteries; D, vesicouterine fold; E, ligature on round ligaments; F, ligatures on the tube and the round ligament of each ovary.

artery is tied by the assistant and is cut close to the clamp by the operator. *Cut the ligature fairly long and apply no clamps to the ligature on the uterine artery.* Care should be exercised in tying the uterine vessels. In tying this knot see to it that it is tight, square and that there is no tissue between the first and second knots. If some tissue falls in between the knots insert an extra knot. *Tie all sutures with three knots.*

Step 9. Cutting across the cervix.

With the six sutures the blood supply of the uterus has been controlled. The uterus can now be removed by cutting across the cervix. Before the cutting is begun, the assistant places a sponge on a stick behind the cervix. That is put there to catch

any secretion from the uterus or the cervix. This sponge stick is held by the second assistant. In cutting across the cervix the operator attempts to wedge the incision with the apex

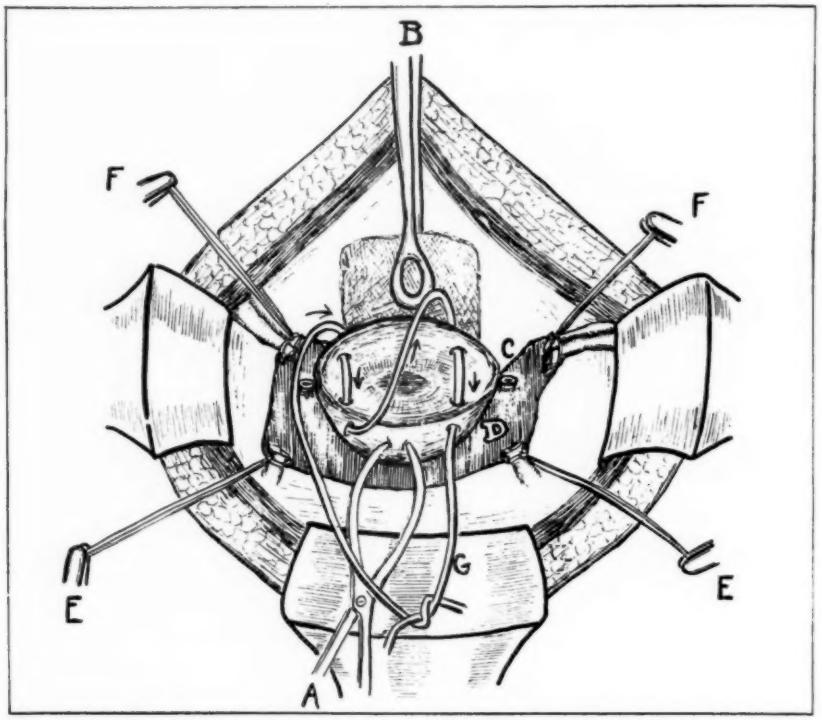

FIG. 76. Step 10. Closure of cervical stump; A, tenaculum on cervical stump; B, sponge on a stick behind cervix to catch secretion; C, uterine artery; D, vesicouterine fold; E, ligature on each round ligament; F, ligature on the tube and round ligament of each ovary; G, suture for closure enters from behind forward on the right side, then on the left, forming a figure of "8" stitch.

downward, going towards the cervical canal as far as possible. This removes a considerable portion of the cervix and also gives a good surface for coaptation. This can be done either with a knife or scissors. All secretions from the cervix or uterus should fall on the sponge behind the cervix. While the operator is cutting across the cervix with a knife, the first assistant grasps the anterior lip of the cervix with a tenaculum, so as not to lose control of the cervix (Fig. 75). The uterus and the scissors or knife used are discarded; the sponge behind the cervix is also discarded and a new one introduced. The operator washes his hands before he goes back into the oper-

ative field. The cervical canal is sterilized with iodine on an applicator and the applicator is discarded. The excess iodine is wiped away with a sponge on a stick and the sponge is discarded.

Step 10. Closure of the cervical stump.

Suture 7 is used, No. 2 plain catgut, cut in two, on a cutting needle (spear pointed needle). A cutting needle is used for this suture because there is great difficulty pushing a round needle through the cervix. The cervix is closed with a running figure of "8" stitch. This suture is introduced from behind forward beginning on the posterior lip of the right side of the cervix and emerges close to the center of the cervix (Fig. 76). The needle is introduced into the cut edge of the anterior lip, going from behind forward, coming out on the anterior wall of the cervix. The operator holds the two ends of this suture and introduces the needle into the posterior and then into the anterior lip on the left side. This suture is tied and left very long. A Kut-Klamp is applied and the end of this suture is bound around the self-retaining retractor to hold the cervix in the wound. Remove the tenaculum (Fig. 76, A).

Dont's

1. Don't have the needle enter the cervical canal.
2. Don't have the mouse-tooth forceps touch the cervical canal.
3. Don't touch the uterine artery with the needle or forceps.
4. Don't touch the ligature on the uterine artery with the needle or forceps.

Step 11. Suture of round and broad ligaments to cervical stump on left side.

Suture 8 is introduced through the posterior lip of the cervix from behind forward (Fig. 77, A); it emerges near the center of the cervix. It is brought over the edge of the broad ligament and grasps a small piece of peritoneum in the avascular zone (Fig. 77, B). It goes over the edge of the round ligament and the needle is introduced (Fig. 77, C) into the anterior lip of the

cervix. The two ends of this suture (Fig. 77, A and C) are held by the assistant. The ligatures on the round and broad ligaments, D and E, are drawn to the patient's right by the assistant

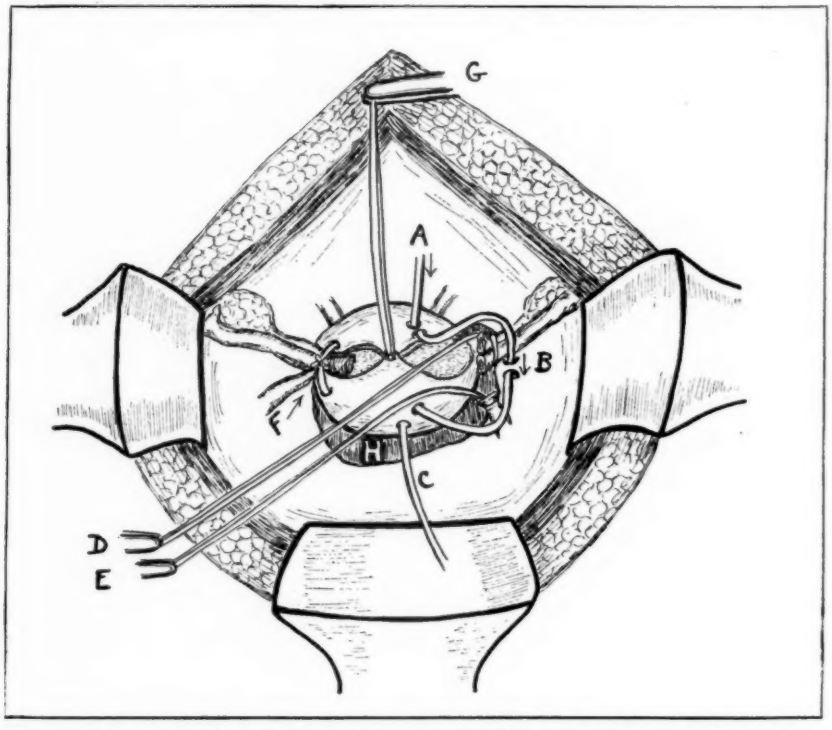

FIG. 77. Steps 11 and 12. Suture of the round and broad ligaments to the cervical stump; suture A is passed from behind forward grasping cervix behind B, going through avascular space, C, grasping anterior lip of cervix. As this suture is drawn taut the ligatures D and E on the round and broad ligaments are drawn medially so as to be included in the ligature; F, ligature on the right side completed; G, suture from step 10 which closed cervical stump; H, vesicouterine space and fold.

while the operator ties suture 8. This suture pulls the broad and round ligaments into the cervical stump. All three sutures are then cut.

Step 12. Suture of the round and broad ligaments to the cervical stump on the right side.

The round and broad ligaments are sutured (suture 9) to the cervical stump in the same manner as on the left, except that the assistant ties the ligature and the operator draws the round and broad ligament suture toward the patient's left.

Step 13. Peritonealization of the cervical stump (suture 10).

This suture is the other half of suture 7. It is of No. 2 plain catgut, cut in two, on a small Mayo needle. This suture draws the peritoneum over the cervix. Suture 7 is left long

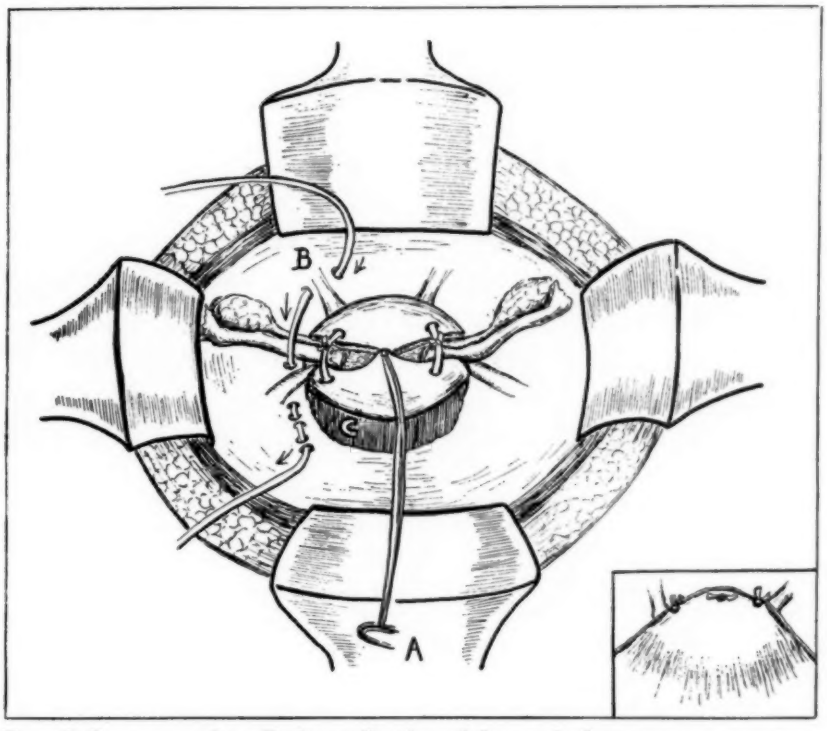

FIG. 78. Steps 13 and 14. Peritonealization of the cervical stump. A, suture 7 on cervical stump; B, right uterosacral ligament. Suture goes through right uterosacral ligament from left to right, then passes through edge of round ligament and finally catches the edge of the vesicouterine fold; C, when this is tied it draws the edge of vesicouterine fold back to the uterosacral ligament. Step 14. Same procedure is carried out on the left side. Insert shows last stitch catching loose edge of vesicouterine fold and closing over all raw surfaces.

and controls the cervix. The right ovary is lifted to the patient's right with a spatula retractor or sponge stick, exposing the right uterosacral ligament. The operator grasps the right uterosacral ligament with a mouse-tooth forceps and the needle with suture 10, is passed through it from left to right (Fig. 78). The needle is drawn out and passed through the edge of the round ligament. The suture goes from behind forward. The suture then takes a third bite in the cut edge of the vesicouterine fold of peritoneum. The third bite enters on the peri-

toneal surface and emerges on the peritoneal surface, so that when the suture is tied to the end in the uterosacral ligament, it will bring peritoneum to peritoneum and no raw surface presenting. This suture does two things: (1) it peritonealizes the cervix, (2) it lifts the right ovary to the patient's right and holds it there. This suture is cut and left long with a Kut-Klamp on its end.

Step 14. Take the same suture and carry out the same procedure on the left side, catching the left uterosacral ligament, from right to left, left round ligament and cut edge of the vesicouterine fold on the left side. This suture is tied, and the end clamped. Holding these two sutures, one controls the cervical stump. Suture 7 is now cut and as many sutures as necessary may be inserted to cover the raw surface of the cervix, suturing the vesicouterine fold of peritoneum to the posterior wall of the cervical stump (Fig. 78 insert).

This routine is for hysterectomy without removing the tubes and ovaries. If the tubes and ovaries must be removed, the only change in technique is that instead of placing the clamps, in Step 3, on the broad ligament, they are placed through the same opening but further out on the infundibulopelvic ligament. When this is done the infundibulopelvic ligaments occasionally cannot be brought down to the cervical stump in Step 11, in which case they are buried with a pursestring suture and the rest of the peritonealization is carried out as described. Many believe that the cervix is sutured to the round and broad ligaments as a support for the cervix. This is not so. The suture of the cervix to the round and broad ligaments is simply an aid to peritonealization.

Complications that May Arise during the Operation

Bladder Injuries. In doing a hysterectomy, *always think of the bladder.* Never forget it until the operation is finished. As the peritoneum is opened, think of the bladder. After a hysterectomy always examine the bladder carefully to be sure no injury has taken place. These injuries are not serious, if recognized and properly sutured. The mortality in cases with recog-

nized and treated bladder injury is not materially higher than in any other gynecological procedure. If there is any question as to an injury to the bladder, treat it as if it were injured. When the injury is disregarded, the patients usually die of a peritonitis.

For closure of the bladder wounds, interrupted or continuous sutures of fine chromic catgut on an intestinal needle are used. This suture catches all the layers of the bladder but does not enter the mucosa of the bladder. If the mucosa is entered, the catgut will act as a nidus for a stone in the bladder. A second layer of continuous sutures should be placed over the first. It is better to use two or three layers to close an injury to the bladder. Drain all cases of bladder injury through the vagina or through the abdomen. A retention catheter is inserted in all cases where the bladder is injured and should be allowed to remain for seven to ten days.

Ureteral Injuries. Intraligamentous and cervical fibroids may dislodge the ureter and the latter may be injured. A fibroid differs from carcinoma in that it does not surround the ureter; it dislodges it but the ureter is always on the surface. To avoid injury to the ureter in removing these fibroids, stick close to the tumor mass. In removing these tumors do not cut any structure that looks like a collapsed vein until it has been traced to its origin, or the ureter has been identified. If the ureter is cut across, there are three methods of procedure: (1) cut the upper end of the ureter at an angle and invaginate the upper into the lower end (Fig. 79) and (2) ligate the proximal end of the ureter with a heavy silk ligature; this will cause the kidney to cease to function. (3) If the ureter has been lengthened by the tumor and the bladder is sufficiently high, the ureter may be implanted into the fundus of the bladder using the same technique as when the proximal end of the ureter is invaginated into the lower end of the ureter. The opening in the bladder should be closed around the ureter in two layers.

Kelly and Cullen recommend that where there is a question as to the ureter having been injured and it cannot be dissected

out, the bladder should be opened and a catheter introduced from below up to identify the ureter. That is a procedure to remember and the less often used, the better.

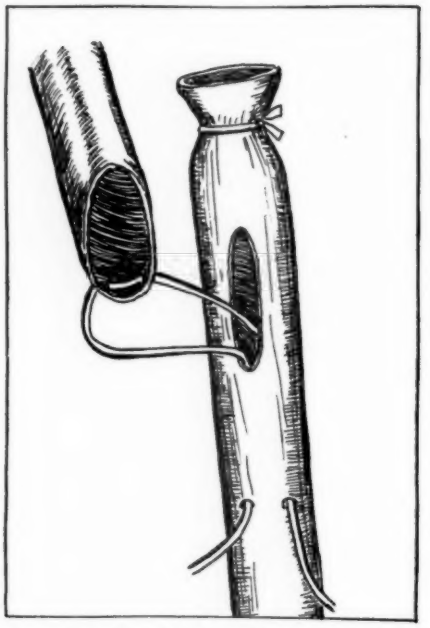

FIG. 79. Invagination of the upper into the lower end of a cut ureter.

Operative Complications to the Rectum. The rectum or sigmoid may be adherent to the tumor mass, lifted out of the pelvis and may be injured during the operation. There may be a muscular tear or a tear extending into the lumen of the bowel. If there is any question of injury treat the bowel as if an injury had taken place. If the adhesions between the tumor and the bowel are dense, *leave a piece of tumor on the bowel rather than a piece of bowel on the tumor.*

Muscular tears of the rectum should be closed with sutures of fine chromic catgut. If the bowel is opened it should be closed in two or three layers with fine chromic sutures. The gloves, needles and instruments used for the closure should be discarded. Drain all these cases vaginally or abdominally but do not put the drain over the suture line. Drained sigmoid injury cases may develop a fistula. If there is no tuberculosis of the intestine present this fistula will usually close spontaneously.

In rectal injury cases the patient is to receive no fluids by rectum, no enemas, no cathartics. All rectal injury cases should have a large rectal tube inserted about the point of injury whenever possible, so as to drain the bowel and remove any gas pressure from the line of suture.

Vaginal Myomectomy

Where a pedunculated vaginal tumor complicates a multiple fibroid uterus, it is advisable to take care of the vaginal tumor first. Patients have been operated on successfully where a hysterectomy has been performed and on cutting across the cervix the pedicle of the vaginal tumor was cut across and the vaginal tumor allowed to drop into the vagina and removed from below. In this method the chances of infection are too great, because the cervix is patent, the pedicle infected and the uterine cavity may also be infected. It is far wiser to remove the vaginal tumor first and at a later date, after two menstrual periods so as to give the uterus a good chance to sterilize itself, to remove the uterus.

In the removal of the vaginal tumors, always remember:

1. The tumor is attached somewhere in the uterine cavity;
2. Other pelvic pathology may be present (pus tubes);
3. The myoma may be clean or infected; and
4. Do not lose control of the pedicle or an uncontrollable hemorrhage may occur.

As the tumor is always attached somewhere in the uterine cavity, traction on the tumor may invert the uterus and draw down a piece of fundus as part of the pedicle. In cutting across such a pedicle, one may buttonhole the fundus and cause a peritonitis.

Other pelvic pathology or pus tubes may be present. Rupture of these pus tubes may result from too great traction on the tumor mass and the uterus with subsequent general peritonitis and death.

If the pedunculated myoma is clean and the vagina is small, an incision to enlarge the vagina can be made. But if the myoma is infected, under no circumstances should an incision

in the vagina be made as it will become infected and the patient may die of sepsis. In infected myomas take every precaution not to injure any of the tissues, vagina or cervix

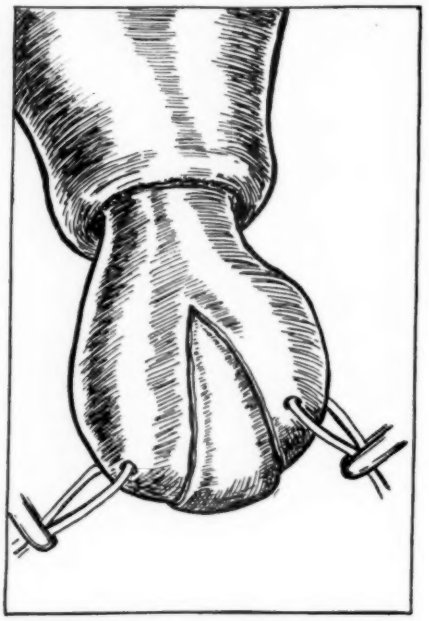

FIG. 80. Method of removing a pedunculated fibroid presenting through the cervix. Traction sutures holding tumor while a wedge shaped piece is excised from the middle.

as they may be a portal of entry for organisms. Do not curette the uterus after the removal of a pedunculated myoma for the same reason.

Do not lose control of the pedicle. The tumor may be removed piecemeal, taking portions away from the center, thus reducing the size of the mass and allowing the pedicle to become accessible (Fig. 80).

The lateral portions of the tumor can be controlled with traction sutures. Place a suture in the outer portion of the tumor mass and cut it long. Excise a wedge-shaped piece from the center, which allows a gradual approach to the pedicle. The use of suture ligatures as traction ligatures are good as they also help to control hemorrhage. It is not necessary to remove all of the pedicle, as it is not tumor tissue.

The pedicle above the tumor should be ligated if possible. If control of the pedicle is lost and it falls back into the uterine cavity with bleeding, the uterus may be packed with iodoform gauze.

Frequently in the removal of these pedunculated fibroid masses a line of cleavage is found and the tumor mass enucleated (myomectomy). When the major portion of the tumor mass is removed the pedicle is made accessible for a tonsil snare which may be slipped just over the tumor mass and closed very gradually. This slow cutting with the snare or the use of a coagulating current through the wires will help control the hemorrhage.

[*To be continued in subsequent issues.*]